THE IRON TRADE REVIEW

VOLUME XXVIII. CLEVELAND, O. JANUARY 3, 1895. CHICAGO, ILL. NUMBER 1.

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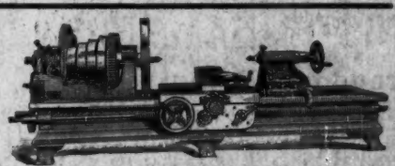

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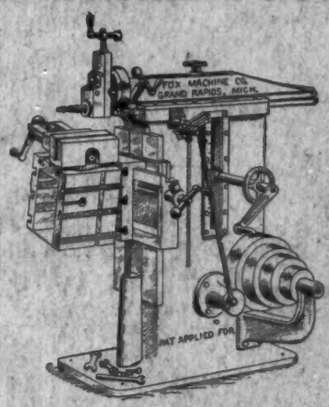

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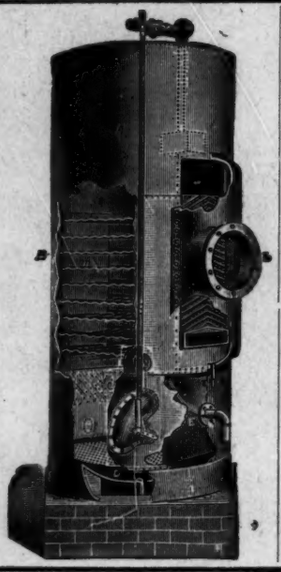

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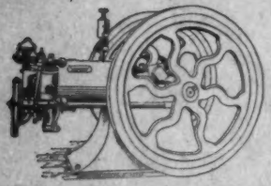

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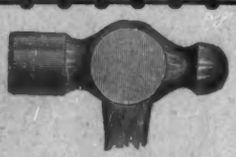

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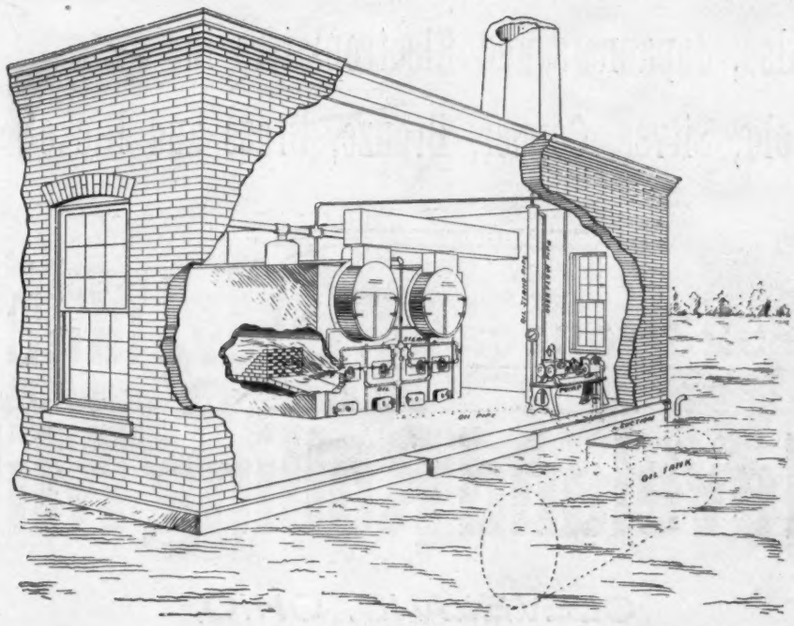

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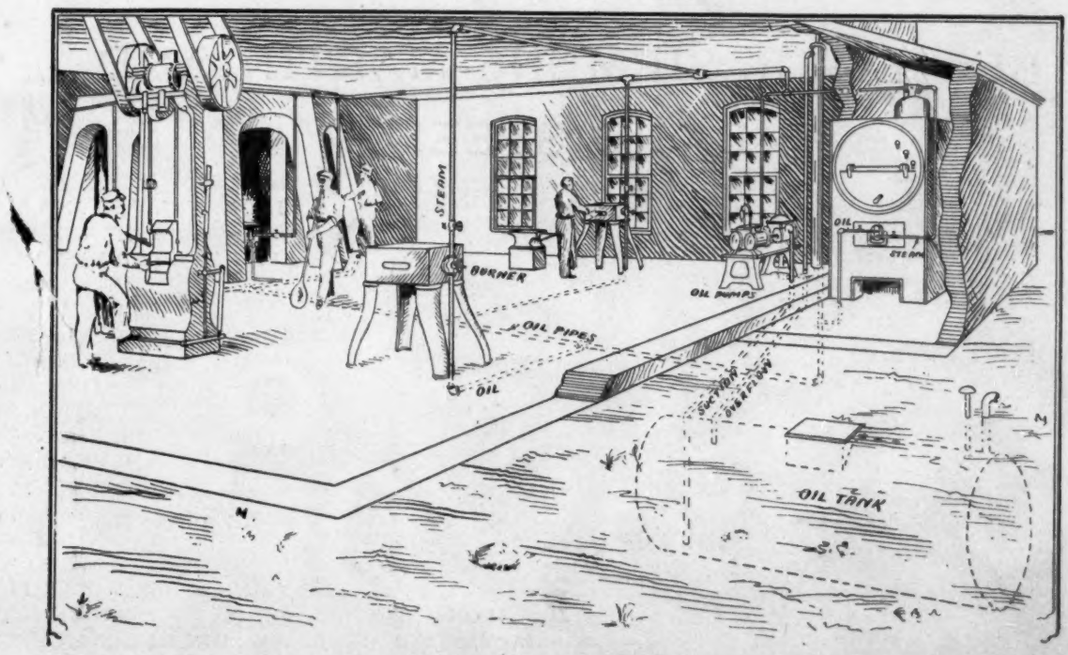

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THE IRON TRADE REVIEW

VOLUME XXVIII. CLEVELAND, O. JANUARY 3, 1895. CHICAGO, ILL. NUMBER 1.

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

What is or is not done in iron and steel in the last week of an old year and the first week of a new one does not signify so much as the indications as to future business that are at such times most closely scanned. There may be more of hope than of prophecy in the general confidence expressed that the new year is to be one of enlarged demand; but the old reason for this belief still holds good, as most frequently applied to the railroads: that as imperative requirements have not been met yet, they soon must be. Wage statistics and railroad earnings statements concur in showing improvement over 1893, with continuing, though lessening decline from 1892. A greater aggregate of wages is being paid in industrial establishments than at the same time one year ago, and all comparisons that go back a twelve-month show the gradual advance to heavy consumption. It is nowhere believed that the railroads can go through another year with purchases of less than three-quarters of a million tons of rails for both new mileage and renewals, yet the immediate developments as to rail contracts are no more promising than a month ago, barring the expected requisition from the Pennsylvania Co. In active business through the holiday week, the East appears to lead, with Chicago and the Central West quiet in most lines. At Philadelphia inquiries received both in raw and finished materials indicate that January will exceed expectations. Eastern furnaces are holding prices steadily and have accumulated little stock. The November increase in coke iron stocks in Western Pennsylvania and Eastern Ohio furnace yards are responsible for the weakness evidenced in those sections the past fortnight, with Bessemer still selling at $10@10.15 at Pittsburg, admittedly cost for some furnaces. The run of foundry iron buying in early December has been followed by a distinct lull, in the Central West, with some prices named here and there on the little business up, that would ordinarily stagger belief. Yet in the Eastern and Western selling centers, the lines have been held with much more firmness. In finished material the East reports two sizeable plate contracts. Other good business is pending and the shipyards are counted on for some January buying. Structural developments in Eastern cities, particularly New York and Boston, have been encouraging and mills west of the Alleghenies are not likely to stand too stiffly on price when the work is given out. Billets have been weaker at Pittsburg and the shading of $15 is reported the past week, but it is known that even a modern mill only entertains such a proposition to bridge over the uneasiness following the holidays. Bar iron men east of the mountains are getting together to stop the elimination of extras, and to put the trade on a better footing—something the Western manufacturers have been unable yet to start to accomplish. The 30,000 ton contract for steel rails let by the Pennsylvania Co., and divided between Pittsburg, Scranton, Johnstown and Steelton plants, is a beginning in that direction, but its size is indicative of the caution with which all railroad obligations are made.

THE CLEVELAND OUTLOOK.

The holiday weeks have not been entirely without transactions in iron ore. One sale of 15,000 tons of old range product has been closed recently and something has been done in a small-lot way in Mesabis. The question that has been of uppermost import to furnacemen as well as ore selling firms in the weeks since navigation closed—namely, the basis of ore contracts in 1895, is still unsettled, though there are predictions abroad that are not likely to be far out of the way. It has practically narrowed down to a question as to the size of the advance that will be asked and as to the distribution of the increment among interests that have suffered together in the year just ended. An important development that has an interest for iron ore as well as vessel companies is the transfer of the management of the American Steel Barge Co.'s whalebacks, heretofore operated by the owners, to Pickands, Mather & Co. This step does not necessarily imply that the whalebacks will carry Minnesota Iron Co. ore to any greater extent than formerly or that they will be used to any less extent than in the past season, in bringing down Lake Superior Consolidated ore from the Mesabi. It is not understood to mean, moreover, that any closer bond is created between the two leading producing companies on the Mesabi range, or that the handling of ores is at all affected.

Pig Iron. The reports from Pittsburg in the past two weeks have not been encouraging to valley producers of Bessemer pig and the policy with most of them has been to stay out of the market and let the worst blow over if it will. Should the strike at Braddock continue for any length of time or extend to other classes of the furnace workers there, the effect might be to impart some strength to the Bessemer market, in case the converters depending on these furnaces are supplied by purchases in the market. The $9.40 valley sales reported recently represent the lowest figure that can be verified. Iron has been piling up for six weeks in some furnace yards, and there are producers here and there who are willing to sell two or three months ahead on the present basis, in view of the $1 coke contracts that are assured to April 1, and even to July 1. Furnaces nearest the Ohio Steel Co.'s plant will doubtless be called upon for considerable metal in the near future, both for the running of the plant and for the reserve which will doubtless be carried at the new mill. Foundry iron has probably seen its dullest period in the past week, and $9.50 for No. 2 at furnace and $10.50 for No. 1 no longer represent the depth of the cutting.

Finished Material. The proposition made last week by two Youngstown mills to their puddlers, to give them steady employment, regardless of demand, at $3 a ton instead of $4, represents the ultimate result of such a market as has been seen in bar iron the past half year. Demand is stationary, and the next move is that expected from the car shops in response to railroad requirements, whatever they are and whenever they come. There has been in the local market more than the average holiday business of late, with signs that in finished steel some good buying will develop in January. Plates are uncertain as to quotations, the effort to keep out of the rut of cut prices being successful only in spots.

THE CHICAGO OUTLOOK.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

As was to be expected, Christmas week was quiet, and, generally speaking, sales of material were small. Pig iron had a surprisingly large sale, as several good sized orders were taken, and the total tonnage was fully as large as the week previous. Other classes of material had only small sales, but the inquiry for the new year continues excellent, and while it is hardly likely that any very large sales will be closed in the first two weeks, it is expected that the balance of January will develop a good demand.

PIG IRON.—The tonnage secured by the local furnaces last week was much larger than had been expected. A sale of 1,200 tons, one of 1,000 and three or four of 500 were made; the car load trade was lighter than usual, but the aggregate was quite as large as that of the week previous. No large sales of Southern iron were made, the local furnaces getting by far the lion's share of the business. A sale of 200 tons of Lake Superior charcoal was made, at $13, Chicago. Prices are being well maintained on all classes of pig metal, buyers apparently having come to the conclusion that lower quotations will not be made in the immediate future. A good inquiry is being received for next year, and while the first half of January will probably be quiet, it appears likely that a good tonnage will be sold in the balance of the month. Prices are made as follows:

Lake Sup. Charcoal.....	$13 00@14 50	Southern No. 2 Soft.....	10 00@10 25
Local Coke Fdy. No. 1...	10 25@10 50	South'n Silveries No. 1.	$11 50@11 75
Local Coke Fdy. No. 2...	9 75@10 00	South'n Silveries No. 2.	11 25@11 50
Local Coke Fdy. No. 3...	9 40@ 9 65	Jackson Co. Silveries...	15 00@16 00
Local Scotch Fdy. No. 1.	10 25@10 50	Ohio Silveries No. 1.....	14 00@14 50
Local Scotch Fdy. No. 2.	9 75@10 00	Ohio Silveries No. 2.....	13 00@13 50
Local Scotch Fdy. No. 3.	9 50@ 9 75	Ohio Strong Softeners...	13 00@13 50
South'n Coke No. 1.....	11 00@11 25	Alabama Car Wheel.....	17 50@18 00
South'n Coke No. 2.....	10 25@10 50	Malleable Bessemer.....	10 50@11 25
South'n Coke No. 3.....	9 75@10 25	Coke Bessemer	11 25@11 50
Southern No. 1 Soft.....	10 25@10 50		

BARS.—The week was very quiet, only a few small orders being placed. The demand for the new year continues, and it is probable that the amount of business closed in January will be large. Prices are well maintained, and are made at 1.05c. to 1.07½c, for common iron; guaranteed, 1.15c. to 1.20c.; steel bars from strictly billet stock, 1.25c.

RAILS AND TRACK SUPPLIES.—One or two small orders were taken last week, but there are no new developments in the way of large business. Prices are as follows: Rails, $23; splice bars, 1.30c to 1.35c; track bolts, 2c to 2.10c; spikes, 1.65c. to 1.70c.

STRUCTURAL MATERIAL.—Business has been very quiet, and only a few small orders were placed. Prices are made, beams and channels, 1.45c to 1.50c; angles, 1.40c to 1.45c; plates, 1.40c to 1.45c; tees, 1.65c. Small lots from stock are quoted at from ¼c to ½c higher.

BILLETS AND RODS.—Little buying was done last week, but the demand for delivery the new year is still large. Prices are unchanged at $17 for billets, and $23.50 for rods.

PLATES.—No orders of any size have been placed, and the demand has fallen off quite a little. Quotations are still made: Tank steel, 1.35c to 1.40c; flange steel, 1.50c to 1.75c; firebox steel, 1.75c to 5c; boiler tubes, 75 per cent. discount.

MERCHANT STEEL.—Deliveries on specifications are being called for rapidly, but very little new business is being closed. It is probable, however, that the inquiry will be much better after the first of the year. Prices are as last quoted: Open-hearth spring, tire and machinery steel 1.65c to 1.70c; smooth finished tire and machinery 1.50c. to 1.60c.; Bessemer bars 1.35c. to 1.45c. tool steel, 5.50c to 7.50c.; specials, 11c. and upwards.

SHEETS.—The situation is unchanged, no large business having been taken in the past week. Prices remain at 2.35c to 2.40c for No. 27 common; 2.40c to 2.45c. for steel sheets, at 80 per cent. discount on galvanized sheets.

OLD RAILS AND WHEELS.—The only business closed was a sale of 150 tons of old wheels at $9. Prices are nominal only: Old iron rails, $10.50 to $11; old steel rails, $6.50 to $7 for short, and $8.75 to $9 for long lengths; old car wheels, $8.50 to $9.

SCRAP.—Business is very quiet, and prices are only nominal: No. 1 forge, $8.50 to $9; No. 1 mill, $7; No. 1 machinery, $7.25; axles, $12.50 to $13; cast borings, $3.50; wrought turnings, $5.25; axle turnings, $6.25; mixed steel, $6; heavy cast, $7.50 to $8; stove plates, $5.75 to $6; heavy melting steel, $6.75 to $7.

IN OTHER MARKETS.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Pittsburg. The wage scales at the other Carnegie mills, that have followed closely upon the announcement of that for Homestead have been accepted by nearly all the men. At Braddock, several hundred ore wheelers who were reduced from $1.40 to $1.20 quit work Jan. 1, and all the furnaces but one, running on spiegel, were banked, pending the securing of a new force. Some temporary delay in resuming operations at the mills may result from the suspension of the metal supply. The changes in wages in the various plants of the company affected the tonnage men most, though in the city mills several classes of workmen paid by the day were reduced about 10 per cent. In the market little has developed in the week beyond additional weakness in steel. It is not disputed that some of the recent transactions in Bessemer were at or below cost, and it is quite as generally admitted that a change for the better must come; but evidences of it are delayed. The heavy output of pig metal lately—at a rate two thirds larger than that of twelve months ago—is not reassuring, but with large amounts of work reported in sight, that will require iron in the next three months, and stocks less than those of a year ago, the piling up of metal in December is not regarded as threatening. The sales of Bessemer reported in the week are at $10 to $10.15. Foundry iron has been practically off the market. In gray forge little has been done and the range is $9.35@$9.50. The sales of billets last week at $15 have been followed by others on the same low basis, and a figure shading $15 is reported, one or two transactions being named on a $14.80 basis. It is evident that the best plants in this district (and one mill is credited with equipment saving it 15 cents a ton over the lowest cost elsewhere) are getting out actual cost of conversion and nothing more, on such figures. Buyers have not shown any great anxiety to close, though a fair amount of buying is expected this month. Some local bridge work is to be let and the mills have taken some orders east on which deliveries will soon begin. Quotations continue to be made at 1.25c.@1.35c. on beams and channels. The rail demand has made but a small beginning. In bars the low prices heretofore noted .90c.@1c. still rule. Inquiries made indicate a good business in both iron and steel bars in January. Black and galvanized sheets are in better demand, but at 2.15c. for No. 27 common iron sheets sellers are not loading up with long-time deliveries.

Boston. The advance in "rail and water" freight from the South has come; at least the trade has received official notices from two lines that a freight rate 25 cents a ton over present rates on pig iron, will go into effect Jan. 1st. This would naturally advance the value

of the metal at the point of delivery, and neither the consumer nor the producer would reap any benefit from it. Buyers, however, still believe that they will be able to purchase as low in January as they could during December, and continue to purchase in small lots, ranging from a car load to 100-ton lots.

Buffalo. Nothing in the way of large new business has developed during the week. Inventory's blighting influence is now being felt, and is blocking shipments on old orders. There are some evidences, however, of more general consumption, if not of increase, in each individual case.

Philadelphia While business is not expected to be active at this juncture, some good orders have been given out in the past 10 days, and from the number of inquiries it would seem that January will be better than was looked for. The new adjustments of wages at Pittsburg do not encourage the belief, however, that there will be steadiness in prices in the early weeks of the year. Sales of pig iron have been on a fairly liberal scale, and with the exception of Bessemer, prices are steady. Local furnaces are well sold up, and as deliveries are promptly taken, there is no accumulation of stock. The weakness in Western markets seems to be the only thing likely to exercise an unfavorable influence. In billets there is not much disposition to make bids. There are sellers at $17.25 to $17.50 delivered, but buyers hold off. Considering the season, mills have done well lately. Small lots have been in active demand, and one order for 700 tons was closed with other important business pending. Prices are very low, however, and for the present, there is not much prospect of improvement. There is a good deal of inquiry for old material and it looks as though somewhat better prices might prevail in the near future.

Cincinnati. In the small-lot demand from the jobbing foundries in the past week, sellers of Northern iron have yielded still further on prices and Southern iron has come down correspondingly. A fair run of orders from different classes of consumers has been received, but there is no desire among buyers to contract in advance of their necessities, though after inventories are taken it is expected that negotiations will be taken up. Several good-sized contracts are expected by the middle of the month. Pipe founders are making heavy heats and general founders are fairly busy. Mills in this district are running on short time; they are counting on an enlargement of railroad supply purchases, but these have not developed as yet.

DECORATIVE iron work from the well known Chicago specialists in this line is to be found in the largest and finest buildings in forty of the most important commercial centers in this country; in the capital city of Germany and in the City of Mexico. In Chicago, but few of the modern commercial, public and educational buildings are without an equipment of ornamental iron from this house, the record embracing over 70 monumental structures; and when it is understood that the contract price for the ornamental iron in some of these structures reaches $125,000 and rarely falls below $10,000, some idea is conveyed of the magnitude of the business in this one center.

THE programme announced for the 44th meeting of the Foundrymen's Association at Philadelphia, Wednesday evening, Jan. 3, included an address by Simpson Bolland on "Loam and Dry Sand Molding, Compared with Green Sand as to Economy and Adaptation." It was announced also that the subject of "Converting White Iron Castings into Steel" would be further discussed.

ANDREW CARNEGIE'S VIEW.

A Silver Sword of Damocles Hangs Over Business.

In response to the request of *The Iron Trade Review* for a word as to the industrial and financial outlook for the United States, Mr. Andrew Carnegie sends the following, which will be read with interest by iron and steel manufacturers everywhere:

5 WEST 51ST STREET, NEW YORK, Dec. 27, 1894.

TO THE EDITOR OF THE IRON TRADE REVIEW:

It seems to me that 1895 is going to be a better year for the iron and steel trade than its predecessor, now slowly dying; how it could be worse, it is difficult to conjecture. But the Sword of Damocles hangs over every phase of business in the United States. That sword is of silver. Until the country plants itself firmly and forever upon the platform of money of the highest standard of value, no forecast is worth much. We never can have permanent and genuine prosperity without first settling the standard of value. At present, capital, not only at home but throughout the world, is alarmed. No prudent investor abroad will place his capital here, and numbers are quietly withdrawing it. This was to have been expected and is only natural.

When one act of Congress, or the failure to pass an act, may reduce the value of every dollar invested by one-half, it is in vain we seek prosperity.

My friend Edward Atkinson has just called and I have read this to him. He concurs fully and says: "All the material conditions of this country are conducive to a period of great prosperity, never greater; nothing stands in the way but the threat of the degradation of the standard of value."

Very Respectfully Yours,

Andrew Carnegie

THE works now being built by the Johnson Co., at Lorain, O., will consist of six large blast furnaces, a converting department capable of converting the product of the furnaces, and a rolling mill plant of about double the capacity of the present plant at Johnstown. The chief product of the rolling mills will be girder rails such as are used in the construction of street car lines, though by a modification of the plant it may be turned to the manufacture of T rails for steam railways without great expense. In addition to the girder rails the company will manufacture material for car springs, truck bearings and such other parts of traction cars as are made of steel, including thin plates for roofing, siding, vestibules and the like. The company will be prepared to furnish steel at a guaranteed margin below the Pittsburg price to steel-consuming industries locating in the environs of Lorain.

THE Northern Steamship Co., and the Globe Iron Works Co., Cleveland, have issued invitations for the launching of the twin screw steel passenger steamship North Land, at the ship yards of the latter company in Cleveland, Saturday afternoon Jan. 5. The new steamer is in all respects a reproduction of the Northwest.

THE IRON TRADE REVIEW

DEVOTED TO
IRON AND STEEL MANUFACTURE, FOUNDRY AND MACHINERY TRADES, IRON ORE PRODUCTION, TRANSPORTATION, AND GENERAL INDUSTRIAL PROGRESS.

PUBLISHED EVERY THURSDAY BY
THE IRON TRADE REVIEW CO.,
CLEVELAND, OHIO.

CLEVELAND:
27 VINCENT STREET.
A. I. FINDLEY, Editor.

CHICAGO:
1141 MONADNOCK BLOCK.
B. M. GARDNER, Associate Editor and Western Manager.

TERMS OF SUBSCRIPTION, (strictly in advance):

One year	$3 00
Six months	1 50
Three months	75

Advertising Rates Furnished on Application.

The Cleveland News Co. will supply the trade with THE IRON TRADE REVIEW, through the regular channels of the American News Co.

ENTERED AT THE POST OFFICE IN CLEVELAND, O., AS SECOND CLASSMATTER.

JANUARY 3, 1895.

OUR "TRADE REVIVAL NUMBER."

The use of the above sub title for to day's issue of *The Iron Trade Review* does not signify a belief that the country has entered upon a new period of prosperity, in the old sense of that word. There are too many signs of adversity abroad to justify any such optimism. It was decided to make this first issue of a new year exceptional in size and in quality because of the abundant evidence that 1895 is to be a better year than either that preceded it, and because of the hope that before it ends the way out of industry's besetments will show more clearly than is possible under to-day's conditions.

Much of a historical and statistical nature is ordinarily looked for in special issues of journals devoted to industry. To-day's *Iron Trade Review* is not devoted largely to history or statistics. The aim has been to direct attention, by means of specially prepared articles, to some phases of the evolution, on both technical and commercial lines, that has been so rapid of late in the iron and steel world. If history or figures have been employed, they have been drawn upon rather to illustrate and emphasize change than to stereotype a record.

Beginning with iron mining, no development in that industry has effected such rapid changes in methods or in standards of values as that of which the Mesabi hills of Minnesota have been the scene in the past two years. With all the fragmentary writing on the subject, there will be no lack of appreciative reading of the two articles on the new range by gentlemen who have the means of gathering accurate data and whose views represent, in differing lines, the experience of two years' operations. The effect of the Mesabi discoveries upon prices of steel was originally an uppermost topic; now that it appears that vast amounts of non-Bessemer ores, in some cases intimately related to the Bessemer supplies, must be taken out in the mining of the latter, the part the Mesabi will play in enabling Northern producers of foundry irons to beat back Southern irons will have larger consideration as time passes.

Going to blast furnace practice, no question has had more study in the past year from furnacemen dependent upon lake ores than the amount of the fine, new-range product that can be most advantageously employed in a mixture. Developments in this direction have been exceedingly interesting, and as presented on another page they will be found practically to mark an era in furnace operation. Our sketch of the original Pioneer furnace at Negaunee, Mich., and of its successor, in connection with an outline of the plans for the new enterprise at Gladstone, shows what a long stride the project of 1894 takes in advance of the slowly moving charcoal furnace practice of yesterday. Saw-mills and chemical works, nominally adjuncts, are really the money-making features of the modern charcoal furnace proposition.

The economies of steel-making have never had more searching study than in the year of record-breaking prices just closed. Billets at $15 and Bessemer pig at $10 Pittsburg cause steel-masters to weigh seriously the drift of competitive forces. The year 1894 has seen one large steel-producing company break away from an established center of operations and plant itself further to the west, and closer to the ore supply. President Moxham's answer to the question asked by *The Iron Trade Review* suggests that the past year has marked an era in steel production also. And when it is remembered that the Lorain project involves the ultimate erection of coke ovens and the employment of by-product recovery, '94 is emphasized again as the year in which an American company transplanted to the United States the retort system of coke-production, with its added economies for steel-making.

The year just closing has made history, moreover, in the matter of transportation charges. In iron and steel products it was a year in which the favored-shipper and the special-rate abuse made itself felt as never before. Producers in one section have cried out against the encroachments of competitors in another, helped by the railroads to invade a field from which fair rates would debar them. The more stringent rulings of courts on Interstate Commerce Commission decisions, and the probability of a properly supervised pooling arrangement, mean that proximity to raw materials and to consumers and the possession of special transportation facilities are to count for their full value hereafter. What this means for the Central Western district south of Lake Erie is pointed out elsewhere by an authority on transportation problems. The article is full of suggestion as to this element in the competitions of the new era.

Foundrymen who have bought on long contracts have seen the market regularly fall on their hands in recent years. They have learned, in this unpleasant experience, to study the market with more care, and to keep better step with its shifts. In the Northwestern territory, conspicuously, and to a less extent in the Central West, the past year has seen the advantage in price, as between Northern and Southern irons, change to the side of the former, and with the change has come an increasing use of Northern irons. Foundrymen's comments on this development are given elsewhere. Foundrymen speak, also, on the changes in practice that have come in their business in the past year and its immediate predecessors. And as representative of a force that has plainly had a share in the foundry evolution of the past two years, attention is called to the foundrymen's associations by presenting portraits of the Western society's officers.

The machine shop articles of the number are also dominated by the new conditions that have been forced upon industrial capital in every line in the past year—the necessity of the closest economy in the purchase of equipment, and continual application of the same principle in every operation.

Tin-plate making as an American industry has probably seen more of change in its brief life than any other. How it has fought its way through the ills of infancy, and

how, before it had nearly attained its growth, it was compelled to get into line with new adjustments that rudely shocked some of the maturest of our industries, is told in the article specially prepared for this issue by one who has facilities for knowing whereof he writes.

Much history has been made in American iron and steel industries in the year or two just back of us; and the evolution has been steadily to a purpose. The outcome, as we believe will be inferred from the articles that follow, is such an adjustment of the whole industrial mechanism to the new conditions, as shall put the country again on the road to "good times."

It is the hope that 1895 will bring distinct developments to that end, that prompts this special initial number.

THE YEAR'S DEVELOPMENTS AT CHICACO.

The past year has shown the ability of Chicago and the territory tributary to recover rapidly from even the most severe financial storms. The records of shipments of iron and steel material show that deliveries have increased steadily each month since the first of 1894, and the total shipments for the year from the Chicago market were at least two-thirds as large as those of 1892. They were nearly twice as large as for 1893. The increase in shipments has been accompanied by a steady decline in prices throughout the year. While a good many changes in iron concerns have been made in the past year, none were of any considerable importance. There were comparatively few failures, and none of these affected the general market to any extent. One of the most important developments of the year, from a Chicago point of view, was the change in the relative position of Northern and Southern irons, as regards prices. A year ago, Northern coke iron was selling for $13.50, Chicago, while Southern was quoted at $11.75. In the late summer the announcement was made by the local furnacemen that they intended to reduce their prices low enough to secure the greater part of the pig iron business in their territory. Quotations were consequently reduced and they have gradually fallen since, until they are now made at $9.75 for Northern coke iron, while Southern is selling at a dollar more.

Deliveries of pig iron were very much larger in 1894 than in 1893—nearly twice as large, in fact—and were about two thirds as large as in 1892. Judging from the character and number of inquiries now being received, it appears probable that 1895 will be fully equal to 1892.

In rails, billets, rods and bars, enough business has been done to keep the mill at South Chicago, that at Joliet and the one at Bay View running nearly full throughout most of the year. Prices have been steady nearly all of the year. Finished iron and steel has had a much better sale than in 1893, although at considerably lower prices. The deliveries have been hardly up to the expectations of the dealers, however, as most of them entertained very sanguine views of 1894 at its beginning.

Old material has been a drug on the market during a good portion of the year, and the total tonnage of deliveries made was not much larger than that of 1893, though a considerable increase was expected.

There is a disposition in all departments of the Chicago market to count on large business for 1895, and there are not a few indications of an expansive demand. The year opens with good inquiry for nearly all classes of material, and prices are maintained with more firmness than in November and early December.

CARNEGIE furnaces at Braddock were reported still idle on Thursday.

CLEVELAND IRON AND STEEL MEN.

The group of portraits on page 8 takes in representatives of most of the important iron ore, pig iron, and iron and steel firms whose interests are centered in Cleveland. Naturally the iron ore business is most numerously represented; in some instances a single firm is identified with ore, pig iron and lake shipping properties. One member of the group is connected with companies taking in iron mining, pig iron production and a wide range of steel mill products. Another represents important vessel and dock interests, in addition to iron mining, blast furnace and rolling mill properties. Below are given the names in the order in which they appear, together with the immediate business connection of each, though nearly all belong to two, three, a half dozen important industrial organizations:

M. A. Hanna, M. A. Hanna & Co.; John Tod, Tod, Stambaugh & Co.; E. C. Pope, sales agent Norrie ore; Fayette Brown, H. H. Brown & Co.; W. D. Rees, president Republic Iron Co.; Samuel Mather, Pickands, Mather & Co.; D. Z. Norton, Oglebay, Norton & Co.; James H. Dalliba, iron ore department Pickands, Mather & Co.; John N. Glidden, general manager Arnold Ore Co.; William Chisholm, president Cleveland Rolling Mill Co.; Harvey H. Brown, H. H. Brown & Co.; Wm. G. Mather, president Cleveland-Cliffs Iron Co; Wm. McLauchlan, pig iron department Pickands, Mather & Co.; Earl W. Oglebay, Oglebay, Norton & Co.; B. F. Bourne, president the Condit-Fuller Co.; L. B. Miller, Oglebay, Norton & Co.; Chas. W. Baker, Cleveland sales agent the Carnegie Steel Co., Ltd.; Wm. B. Castle, secretary Republic Iron Co; H. A. Fuller, general manager Union Rolling Mill Co.; James Corrigan, Corrigan, McKinney & Co.

LAKE SUPERIOR IRON MINES.

A hoisting record was made recently at the Auburn mine on the Mesabi—3,300 tons of ore being raised 200 feet in two shifts of 10 hours each. The Auburn is to have a large electric light plant. The property is to be put in such shape this winter that 700,000 tons can be mined in 1895 if desired.

By a refusal of the Secretary of the Interior to reopen his decision in the Hartman-Warren Sioux half-breed suit case in section 30-63-11, near the Chandler mine, the property which has been 10 years in litigation, is held finally by the Minnesota Iron Company and others. On these 40 acres and the adjoining Hyde-McDonald tract probably $150,000 has been spent in litigation, though the only exploration ever done was the sinking of two or three test pits perhaps 6 ft. Thos. Hyde, a poor pre-emptor who a few years ago was offered $75,000 for a relinquishment of his rights, now decided to be worthless, has been for six years living in a hut on the land, which is absolutely a wilderness.

The Champion mine in the Ishpeming, Mich., district resumes mining operations with the new year, employing about 200 men at the start. It is reported that operations will be confined to portions of the mine in which the ore is of fine grade, permitting the payment of fixed charges on the present basis of prices for labor and on the present selling price of ore.

The Aragon mine at Norway, Mich., has been ordered closed down Jan. 15. There are now 250 men at work. The chief reason is said to be an unsettled question of royalty.

With the beginning of the new year the Lake Superior Iron Co. has stopped all mining work at its Old Mine hematite and its Lake Shaft mines. The old mine is practically exhausted and but few men have had employment in it of late.

A trench has been extended 100 feet across the ore deposit recently discovered near the Cleveland lake shaft at Ishpeming, Mich., and ore found the entire distance. The trench is being extended, the ore continuing good.

REPRESENTATIVES OF THE IRON ORE AND IRON AND STEEL TRADES OF CLEVELAND.

1, M. A. HANNA. 2, JOHN TOD. 3, E. C. POPE. 4, FAYETTE BROWN. 5, W. D. REES. 6, SAMUEL MATHER. 7, D. Z. NORTON. 8, JAMES H. DALLIBA. 9, JOHN N. GLIDDEN. 10, WILLIAM CHISHOLM. 11, HARVEY H. BROWN. 12, WM. G. MATHER. 13, WM. McLAUCHLAN. 14, E. W. OGLEBAY. 15, B. F. BOURNE. 16, L. B. MILLER. 17, CHAS. W. BAKER. 18, WM. B. CASTLE. 19, H. A. FULLER. 20, JAMES CORRIGAN.

THE CLEVELAND DISTRICT AS A STEEL-MAKING CENTER.

WHY THE JOHNSON CO. WENT TO LORAIN.

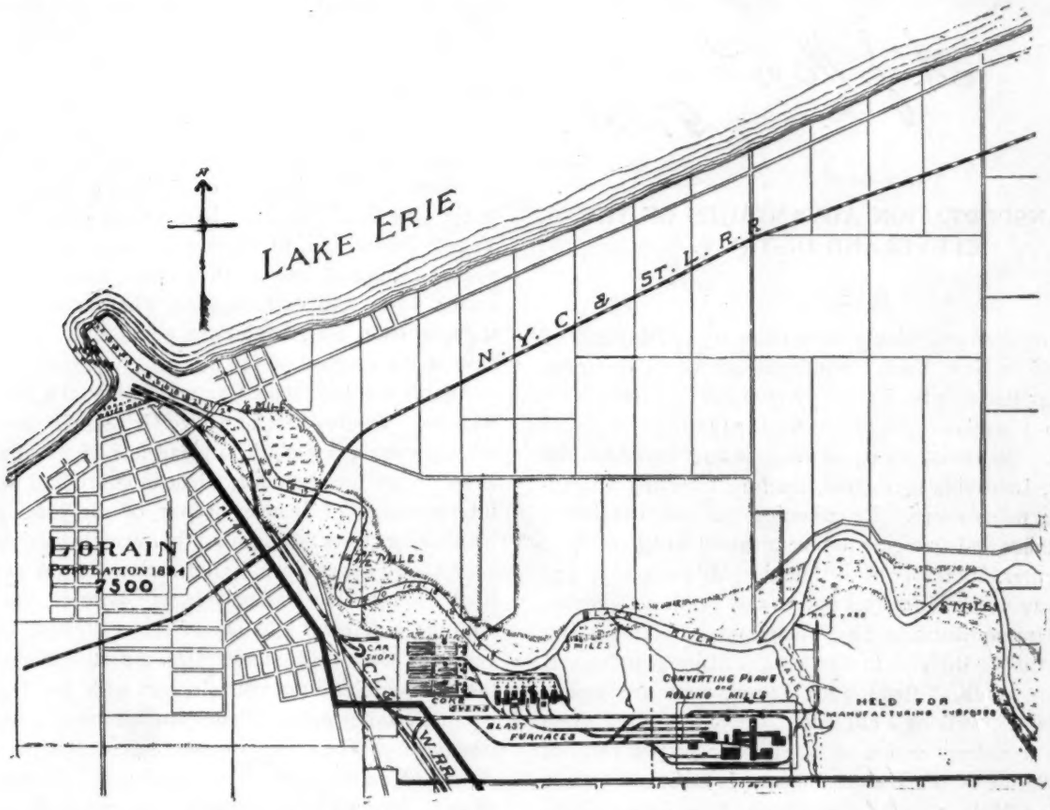
THE JOHNSON COMPANY,
General Office and Works,
JOHNSTOWN, PA., DEC. 20, 1894.

TO THE EDITOR OF THE IRON TRADE REVIEW:

DEAR SIR: You ask me, "What caused the Johnson Co. to move to Lorain?" I reply: Because we wanted to come to Cleveland. We could not quite do it; we therefore got as near to it as the conditions permitted.

For some time the truth was borne in upon us, that the wonderful economies in transportation, effected during the last few years, had been shifting what might be termed the "center of gravity" of the steel manufacturing interests. Moreover, these same economies had also rendered it more necessary than ever to properly guard this "center of gravity." We undertook to try honestly to find it, with the intent, in the event of our doing so, of "getting in out of the wet." We think we have found it in the Cleveland district. At this point the assembling of ores costs no more than at Chicago; the assembling of coke much less. As compared with the Mahoning Valley and Pittsburgh there is a saving on ore and an increase on coke freights; but as it takes 1⅔ tons of ore and only 1 ton of coke to make a ton of metal, the net result speaks for itself. A comparison need not be extended beyond these, as they are the most favored present points. Nor do we think the problem ends with the assembling of material; as a distributing point we think the Cleveland district offers equal advantages. Her many railroads, and central position, guarantee a favorable railroad freight to any business that is general in its distribution. In relation to the great West—the future Mecca of the steel manufacturer—it is advantageous in that it is perhaps the nearest general railroad center to this great market from both points of view; that is, from the point of assembly as well as of delivery. So much for the present. As to the future of these advantages, it need only be stated that we are to day getting out of iron ore all the iron that is in it, and the amount of ore used cannot be further reduced by metallurgical art. It is not so with fuel. As a scientific fact, even our most advanced use is wasteful and there is room for considerable reduction in the amount now used. Therefore, as between ore and coal the future tendency is *toward* the ore and away from the coal.

We think, too, that water freights offer a development not yet realized, for Cleveland's good. The internal water traffic, responding to its only demand, has heretofore cared rather for goods in bulk, such as grain, than for finished articles. With large supplies of finished steel—large enough to guarantee a fair return—there is no reason why special preparation should not be made to meet it,



MAP SHOWING THE SITE OF THE JOHNSON CO.'S LORAIN PLANT.

and if made, secure an outlet east by means of the canals, at a low rate of freight.

Such were our reasons for wanting to come to Cleveland. I will now state how it happened to be Lorain we selected, not Cleveland. In one word: there was no room for us in Cleveland proper. At first this statement was received with skepticism; to-day I think it is accepted by all who have been to our site and witnessed the extent of ground needed.

Cheap raw material needs cheap ground; and there is only one thing that makes ground cheap, and that is—lots of it. Indeed, unless Cleveland bestirs herself, it is even now too late to build the Greater Cleveland as she asks to be built. With her lake fronts tied up by railroads (that would be just as effective up some back alley) and her narrow river almost uncared for and in its present condition already over-burdened, there is not room for those steel plants that are almost knocking at her door. The best that can be done now is to survey the field, find out what *is* left tributary to Cleveland, take it under her wing

and make it part of Greater Cleveland. I myself think Lorain is available, not only because of its grand river (which already has assured to it improvements that will do for it in the future what it is proposed to do for the Cuyahoga to-day) but because of its low-lying shore front, extending many miles towards Cleveland, and its proximity to Cleveland. Already, in the recent annexation of our property, Lorain has taken a step towards Cleveland of nearly four miles, and there now only exists a gap of something like 12 miles between the two points, and that, *12 miles of lake front.* If public sentiment in both places were properly developed, and sectional jealousy frowned down and discouraged, it would be both to Lorain's good and Cleveland's future benefit. Such an amalgamation should be worked for, nay, should be insisted upon.

So that when the chapter is finished we may yet have done what we set out to do: viz., have "come to Cleveland." Many others will come with us.

Yours truly,

A. J. Moxham
Prest.

TRANSPORTATION ADVANTAGES OF THE CLEVELAND DISTRICT.

BY CHAS. E. WHEELER.

Five hundred and ninety-three miles by rail due east of Cleveland is New York. Southwest an equal distance, lacking 45 miles, is St. Louis. A straight line from New York to Cleveland projected west 342 miles ends at Chicago. Southwest an equal distance and an additional 31 miles, Louisville is reached, the line bisecting Cincinnati, 244 miles away. Lengthening out the Cincinnati line 39 miles and swinging to the northwest with Cleveland as the center, Indianapolis is found. Milwaukee is 427 miles away to the northwest and to the southeast practically the same distance lie Philadelphia, Baltimore and Washington. Buffalo to the east, Pittsburg southeast, Columbus south, Toledo and Detroit west are nearly equi-distant. Striking a circle with the outermost of these cities as a radius, within it dwell over 50 per cent. of the population of the United States. It embraces nearly all of New York, all of Pennsylvania, New Jersey, Delaware, Maryland, Virginia, one-half of North Carolina, a portion of Tennessee and most of Kentucky, all of West Virginia, Ohio and Indiana, nearly all of Michigan, and parts of Wisconsin and Illinois. It is safe to say that 75 per cent. of the total products of the country are consumed within the circle thus drawn. The farthest point, New York, is fifteen hours away from Cleveland.

This, then, is the thickly populated section of the greatest market on earth. Its manufacturing district must beyond all controversy lie within the parallelogram described by lines drawn from Toledo southwest to Cincinnati, northeast to Pittsburg, northeast to Buffalo, southwest to Toledo. The commanding position in the parallelogram is held by Cleveland. East of the parallelogram there is no probability of serious competition much longer continuing, formidable though it may have been in the past; south of the Ohio there is but little to fear—the standard of labor is too low and the market too far removed; Chicago to the west, able to-day to manufacture pig iron cheaper than Pittsburg, is hauling Connellsville coke over five hundred miles to do it. That city able to compete with Chicago in ores and underbid her in the transportation cost of coke and limestone, must ultimately lead in manufacturing wherever iron becomes the workman's raw material. There are two cities on the Great Lakes which can do this and surpass all other cities as well; they are Erie, Pa., and Cleveland. The former has missed her opportunity and lacks competitive transportation; the latter is keenly alive to possibilities and has transportation beyond need.

There have been since 1890 a number of economic changes which must, within the next few years, compel iron manufacturers to seek a home within the parallelogram thus described. The period of high prices is gone forever, unless war, famine or devastation of some kind shall so deplete the ranks of labor that its price be advanced abnormally. The margins of profit have been steadily decreasing, and can never be restored to their former generous proportions unless the signs of the times are at fault. The day is departed, or at least rapidly disappearing, when billets and plate can be carried across the Alleghanies, be manufactured into finished products, be transported across the Alleghanies a second time and sold in the markets where the billets and plate were made. It was the apprehension of these truths a little earlier than by his competitors that led Mr. Moxham, President of the Johnson Co., to hasten from Johnstown to the Cleveland district. It was these facts that led the Yale & Towne Co., of Stamford, Conn., to arrange for a similar change of base of their crane plant. Margins are close; waste and extravagance, whether of materials or transportation cost, no longer permissible. It is a clear case of the survival of the fittest.

Again, the Interstate Commerce law is a fact to abide with us. The reversal of Judge Grosscup's decision permitting even a rate clerk to plead fear of criminal liability as an excuse for remaining silent in court, and the farcical interpretation of Justice Brewer of the long and short haul clause, have been promptly overruled by the highest courts, and never since its formation has the commission been stronger than to-day. It will become yet stronger with the enactment into law of the Patterson bill. It is very sure that while secret rates are still made, they are the exception and not the rule, and with the legalizing of pooling arrangements rebates are destined practically to disappear. When that is accomplished the present conditions of carriage will be equitable to all, and concessions to favored manufacturers, the arrest of competitive forces and annihilation of smaller interests must end. In fact, we entered upon that period some years since, and the economic trend has been irresistibly towards a competition free from adventitious aids and working with or against the advantages which nature has bestowed on localities.

What advantages of this kind has Cleveland? Her charming homes, her incomparable public schools, her system of parks, the morality of her people, her city government free from suspicion of corruption, her reasonable tax rate, her bonded indebtedness so low as to make her, next to New York, the favored city of the land in negotiating loans, all these excellencies can exist without a manufacturing center. It may be that being a manufacturing center, it is a surprise Cleveland should possess them; but here they are, helpful to the development of that skilled labor which has built the world's telescopes, a large amount of its electrical machinery, sewing machines that have lightened labor wherever civilization has a home, steel steamships in whose holds is contained each year a tonnage that has dwarfed the operations of Suez in com-

parison with St. Mary's,—in a word, all the diversified manufactures that have given Cleveland the reputation she enjoys.

No less important than cheap production is cheap distribution, and Cleveland's first great natural advantage is her position with regard to the great consuming district, which, as we have seen, contains more than one-half the total population of the United States. Chicago and Duluth are the gateways to the west and northwest; St. Louis to the southwest; Cincinnati to the south; Baltimore to the southeast; New York and Philadelphia to the east. These are the natural outlets to trade of the entire country, and any manufacturing center must be well related to each, if it measures up to the highest requirements. As has been seen, Cleveland is not far removed from the most distant of these gateways, but the competitive routes to can and do operate to share with their strong competitors in the immense tonnage forwarded to the west. It is an advantage of inestimable worth, for when trunk lines are exacting and arbitrary, by reason of pooling arrangements or other combinations, Cleveland is possessed of independent outlets, largely controlled by Cleveland capital, and capable of amply protecting her interests. If further means of carriage are needed, the Detroit & Cleveland Steam Navigation Co., with its daily service and its traffic arrangements with the Michigan Central and Chicago & Grand Trunk, bring in the north shore lines and give to every trunk line on the continent participation in Cleveland tonnage.

To St. Louis, every railroad entering Cleveland quotes rates. The Big Four, the Pennsylvania, the Baltimore & Ohio, all direct routes, must divide the traffic with the

PARALLELOGRAM WITH BUFFALO, PITTSBURG, CINCINNATI AND TOLEDO AT ANGLES—PAGE 10.

reach each have not been shown. As might be expected from her southern location on the great lakes, the trunk lines skirting Lake Erie must necessarily tap her industries; and what an array of railways is found. The Lake Shore & Michigan Southern; the New York, Chicago & St. Louis; the Pennsylvania Co.; the Baltimore & Ohio; the New York, Lake Erie & Western; the Cleveland, Columbus, Cincinnati & Indianapolis, all trunk lines, all competing for Chicago business, give, so far as the western metropolis is concerned, abundant facilities for transport in that direction. And if that be not enough, a fact of far-reaching importance becomes known on consulting a map. *Cleveland is the farthest eastern point from which the south, southwest and west can be reached by a combination of small roads.* The Cleveland, Canton & Southern, the Wheeling & Lake Erie and the Wabash have their traffic arrangements, and furnish but one instance of the manner in which our north and south roads east and west lines, whose connections at Sandusky, Toledo, Fort Wayne and other junction points with the Lake Erie & Western, the Wabash, the Clover Leaf and the Vandalia, give not less than a dozen means of communication with the great southwest. The same applies to Cincinnati, the southern gateway. Seven different routes are open to the shipper to the southeast. Reached direct by the Pennsylvania and Baltimore & Ohio, three other roads, the Lake Shore & Michigan Southern, the Big Four and the Cleveland, Canton & Southern, compete; while New York and New England are traversed by the Lake Shore & Michigan Southern, the New York, Chicago & St. Louis, the Pennsylvania, the Baltimore & Ohio and their affiliated lines.

These, then, are the means of reaching the great distributing centers, centers that are so situated with relation to Cleveland as to make her, other conditions being equal, an ideal manufacturing locality.

But the story is not yet told: North of us extending as far west as Duluth and as far east as navigable water is found, is a route whose cost of maintenance is practically naught, monopolized by no corporation, as free to the fisherman's dory as to the palatial Northwest. Over that route and through the Sault 12,639,872 net tons of freight were transported in 1894, the equivalent of 500,000 car loads of 25 tons each. Load this freight in cars and couple them together and the train would span the continent. A stately commerce this, whose future growth he were a rash man to prophesy. The record is this: A propeller at Ashland or Two Harbors is loaded with 3,000 tons of ore, the boat trimmed, and under way for Cleveland 55 minutes after touching dock. Three and a half to four days thereafter her cargo is discharged upon the docks at Cleveland, the boat loaded with coal and within ten hours after landing steaming north again. This means a transportation whose cheapness may be best appreciated in the simple statement that it costs less to bring a ton of ore to Cleveland by boat from the Lake Superior ranges than it does to bring a ton of coal in by rail from sixty miles to our South. From a transportation or traffic standpoint, then, the account stands as follows:

Coal, sixty miles, southeast.

Fluxes, fifty miles, west.

Iron ore, sixty miles northwest (reducing the water haul to an equivalent rail haul.)

But this is not all. Along these lakes dwell over 3,500,000 people at ports of entry, a market of importance in itself. The merchandise tonnage via the Great Lakes is increasing each year. It has assumed such proportions as to justify the Great Northern Railroad in building a fleet of boats to attend it, and to equip at an expense of $1,400,000 two propellers for passenger traffic exclusively. It has so enlarged that freight and passenger boats ply daily between Cleveland and Buffalo, Detroit and Lake Huron points, for Chicago, Milwaukee, Duluth, Ogdensburg, Montreal, etc. These boat lines pro-rate on through bills of lading with the roads diverging from ports of entry; they bring to our doors the Canadian Pacific, The Northern Pacific, The Great Northern; all the roads out of Chicago; the New York Central & Hudson River, the Delaware, Lackawanna & Western, the Lehigh, and other roads at Buffalo; they open up multiplied means of communication with the world. In vessel property, Cleveland alone has $18,000,000 of capital invested.

During the past season certain articles in the iron list were carried to Portland, Ore., at 20 cents per 100 lbs. Compare the all-rail and the rail and water rates to St. Paul, Minneapolis, Stillwater and common points from Cleveland during the past season:

	CLASS.						IRON LIST.	
	1	2	3	4	5	6	C. L.	L. C. L.
Rail	92	82	63	40	33	28	26½	39
Rail and water	30	25	20	18	15	12	8	12

These are published quotations and have no reference to wild rates to lake ports, rates which have been as low as 5 cents per 100 lbs. to Duluth. It has cost less to send one hundred pounds of iron from Cleveland to Duluth or even St. Paul than to transport it from Pittsburg by rail to Cleveland; it has cost the same to send the same hundred pounds from Cleveland to the Pacific Coast that it has to freight it by rail from the Pittsburg district to interior Illinois points.

During the year 1894, canal boats have been running between New York and Erie, Pa. Already two large Cleveland manufacturers have made arrangements by which they will use the same means to reach the east and New England. Thousands of tons of high class freight are annually carried from New York to Cleveland in canal bottoms at rates ridiculously low. And with the Welland canal deepening to fourteen feet; with New York committed to deepening the Erie canal to nine feet; with the agitation for deep waterways to the sea, by Canada, the states bordering on the lakes and the northwest; with the government committed to a 20-foot channel from Duluth to Buffalo, it seems certain that the importance of the great lakes as a means of cheap transportation is far from being fully realized.

On June 29th, of last year, there was unloaded at Cleveland a cargo of sixth class freight, the through all-water rate on which, from Liverpool, Eng., was $3.70 per ton. Bulk was broken at Montreal and freight reshipped from that point. It has been possible to duplicate the performance this year at $3 per ton, that being the published rate. Cement has been shipped from New York to Cleveland by canal, during the past season, at the rate of 28c per barrel, or 7c per 100 lbs. The use made of the Erie canal by Cleveland manufacturers and merchants is more generous than suspected; it is claimed that during navigation more than one-half of the west bound tonnage seeks that outlet. The average time via this route, between New York and Cleveland, is fourteen days. A comparison of rates, New York to Cleveland, via all-water, rail and water, and all-rail is appended.

	CLASS.					
	1	2	3	4	5	6
All rail	51	44	35	24	21	18
All water	30	25	20	18	16	14
Rail and water	49	42	33	23	20	17

Possessing such advantages for manufacture and transportation, with ample banking facilities, with the contour of country such as to admit of many and cheap sites, with a municipal water service excelled in efficiency by none and in cheapness by but two other cities in America, with a good and economical market for labor, a system of interchange between railroads that entails no switching charges upon the shipper—the steady growth of the city from 261,353 in 1890 to 325,000 in 1894, after an increase of over 60 per cent. in the decade between 1880 and 1890, is not out of proportion with her resources and demands.

CLEVELAND, Dec. 20, 1894.

A NEW ERA IN STEEL-MAKING.

[Reprinted from *The Iron Trade Review* of Nov. 1, 1894.]

Attention has been called in these columns recently to the drift of Bessemer pig iron production the past year, into the districts in which lowest costs are achieved. It was shown that statistical returns tally with what has been inferred from the activity of furnaces nearest Lake Erie ports since the depression set in: that a lower and lower price basis has resulted in a marked decrease in Bessemer pig production east of the Alleghenies, with much enlarged output in the districts of Eastern Ohio and Western Pennsylvania.

It is not a new idea, that with a thoroughly modern mill steel can be made on the southern shore of Lake Erie at a lower cost than at any other point in the country. But up to this time the development of the steel-making industry has been largely controlled by other considerations than proximity to ores. Moreover, the pre-eminence of Lake Superior ores, both in quality and quantity, is a matter of comparatively recent demonstration. The foundations of Pittsburg's greatness as a steel center were laid before lake ores had become even an important factor in steel production. As recently as 1878

the total production of Lake Superior mines was but a trifle over a million tons. And in the census year 1880, only 14 years ago, Pennsylvania's output was 1,951,495 tons of ore, against 1,908,745 tons by the two Lake Superior ranges discovered up to that time.

It is only within a few years, too, that the cost of the long lake haul on Lake Superior ores has reached any close approximation to that of the short rail haul from Lake Erie ports to the furnaces of Allegheny country. In 1880 the contract rate on ore from Marquette was $2.75 to Lake Erie port; from Escanaba in the same year it was $1.85. In the past two years, the average cost of bringing a ton of ore from the head of Lake Superior has been less than the freight from Lake Erie port to Pittsburg, while in the same time, in the case of ore from Marquette and Escanaba, the lake rate has averaged but little more than half the $1.05 paid from lower lake port to Pittsburg furnaces. Thus, while the rapid increase in capacity of lake freighters and decrease in the time required for trips have greatly cheapened Lake Superior ores for all consumers, this minimizing of the cost of the long lake haul has continually emphasized the handicap of the practically unchanged rail freight, upon furnaces more remote from Lake Erie.

Taking account of the saving on coke freight in favor of the Pittsburg district, and deducting it from the freight on 1⅔ tons of ore from lake port to Pittsburg furnace and the advantage in transportation is 65 cents on a ton of Bessemer pig, in favor of the lake shore furnace.

A computation was made by experts and submitted to the Johnson Co. early in the present year, showing that Bessemer pig could be made at Cleveland for $9.21 a ton. This was for 2,300 pounds, casting house weight, with a coke allowance sufficient to smelt a ton of foundry iron, and with liberal allowance for renewals, reckoning labor at $1.00 a ton, standard Bessemer ore at $2.75 and coke at $1.00. That this showing of economy was fully borne out by careful investigation appears in the decision of the Johnson Co. to locate on the south shore of Lake Erie, against its own preference, and with flattering inducements held out to go to points close to the coke supply.

The erection at Lorain, of the six blast furnaces provided for in the Johnson Co.'s plans means the inauguration of a new era in steel making, an era in which economies of location will be joined to the economies of an equipment embodying every new device to lower cost, and the additional economies of buying at farm land prices and selling surplus land at town lot values. The Lorain plan not only eliminates the cost of a site from the account but makes the land contribute to the purchase of expensive equipment, to make the processes of the mill automatic to the largest degree. And what applies to Lorain applies with equal force to other points east and west of Cleveland. With a moderate outlay, excellent harbor and dock facilities could be secured at a half dozen other Lake Erie points. Cleveland itself offers many advantages in respect to location, with pre-eminent railroad facilities in addition. The great steel plant operated in Cleveland for years exemplifies in its continued prosperity, the foresight of its projectors.

It is taken for granted in what is said above, that Lake Superior ores will be more and more the dependence of steel makers of the United States. Their abundance and cheapness make this certain. Today, with the consumption of iron and steel, as of every other product, much below the rate of average prosperity, the use of Lake Superior Bessemer ores is at a rate never equaled. The vast deposits of Mesabi Bessemers seem to have been hit upon none too soon to fit into the new order of lower prices and narrower margins. Their cheapness is already stimulating furnacemen to the adoption of methods that will increase their percentage in Bessemer mixtures. Nothing is plainer in the statistics of the past 18 months than that the furnaces using Lake Superior Bessemer ores are gaining in their percentage of the total output of Bessemer pig while there is a falling off in the output of those supplied with ores from other sources.

Another consideration that had much weight in deciding the Johnson Co. to move to Lake Erie was accessibility to important consuming centers. The south shore of Lake Erie is a great highway, over which passes every year a large share of the country's east and west traffic. In the very heart of the region comprehended by the Central Western States, it lies midway between the country's metropolis on the seaboard and the metropolis of the west. The east and west lines that traverse Northern Ohio are frequently crossed by roads leading into important consuming districts—districts in which population has rapidly increased in the last two decades. The census of 1890 showed that the cities on Lake Erie of 8,000 inhabitants and over had grown in population 60 per cent. in the preceding ten years—the expansion being due in large part to the marvelous increase of the traffic of the Great Lakes in that period. This prosperity was shared also by the region tributary to Lake Erie, through which passed a large proportion of the freight borne up and down the lakes. The coal fields of Ohio and Pennsylvania send millions of tons annually to Lake Erie docks and the north and south lines tapping these fields carry back other millions of tons. No other section of the country is more closely webbed with steel tracks or more thickly set with manufacturing establishments working up iron and steel into varied forms of finished product. Thus steel works on the lake shore have their customers almost at their doors.

In the years of prosperity preceding 1893, the various town-booming schemes that flourished, particularly in the districts finding natural gas, were effectual in securing a very respectable migration of Eastern concerns to the West. Low fuel cost and cheap or absolutely free sites, added to nearness to the Western trade, were irresistible arguments even in the days of good prices, comfortable margins, and the full employment of producing capacity. Now that so much manufacturing equipment is unemployed, the possession of competitive markets will hinge more and more upon the ability to achieve bed-rock costs. And as demand increases, it may be expected that the facilities of the most favored producers will be expanded to take care of it, rather than that unfavorably located plants will return to their former pace. No such advance in prices is expected, as will give these plants all their old markets.

Eastern industries, consumers of raw steel, are already looking in the Central West for locations that will put them on a footing with Western competitors. They are realizing that the steel industry will find its most economic development in a district closest to Lake Superior ores, and affording at the lowest cost a meeting point for lake ores, the limestone of the Marblehead Peninsula and the coke and coal of near-by Pennsylvania and Ohio points. They appreciate the fact that in getting near to steel producers having such a location, they are secure against any shift in the producing center, and that whatever changes occur will only emphasize the advantages of their new position.

FINE ORES IN THE BLAST FURNACE.

BY F. B. RICHARDS.

Soon after the Mesabi range was discovered, marvellous stories came to us from the new range of the wonderful deposits of Bessemer ore, acres in extent, only a few feet beneath the surface and of unrivaled quality. These stories were not altogether mythical, for wonderful deposits of excellent Bessemer ore were found, rich in iron, low in phosphorus and so located by nature that they could be cheaply mined. Others were found variable in iron, manganese and phosphorus, with heavy cover, bringing much disappointment and loss to purchasers of options. In the rush to secure options to prepare for mining ore, and to get rich in a hurry, satisfactory chemical analysis was all that was sought for in looking for desirable properties, and the physical character of the ore and its utility in the blast furnace were almost lost from sight.

The trials of the first cargoes through the furnace suddenly turned every one's attention to this feature of the situation. The ores were very fine and the finest particles very light, the amount of fine ore, such as would go through a 60 and 100-mesh sieve, varying in ores from different localities. A sample of one of the best grades showed about 18 per cent. of the exceedingly fine ore; another sample from a less favored locality showed about 35 per cent. of the fine ore. Considerable of this fine ore blew over with the gases, and exaggerated stories regarding the amount were circulated immediately; also many humorous ones bearing on the fine character of Mesabi ores, such as how all the boiler fires at B.'s furnace were put out by the large quantities of flue dust in the gas, and how a train load of 500 tons of the ore was caught in a wind storm en route to Pittsburg, only 250 tons finally reaching the Pittsburg furnace.

The first results were disappointing and created a prejudice against Mesabi ore at once, a prejudice which, while it still exists in some quarters, is not nearly as strong as at first and is being rapidly overcome, as was the prejudice against the soft hematites, when they were first introduced. Chemically these ores are mainly oxide of iron and silica, there being very little earthy matter, and on account of this and their fineness they reduce with the greatest ease in the furnace.

One of the troubles, when they are used in furnaces of inadequate blast power, is the tendency of the melting zone to rise too high, causing hanging and subsequent slipping. It is under these circumstances that the greatest amount of flue dust is made, the hanging creating high blast pressure, which being suddenly released when the stock moves, carries over the dust; whereas, with a modern equipment this can be largely overcome. Under the conditions stated above, with the furnace working smoothly one day and slipping badly the next, it was a difficult matter to keep the lime charge at the proper point and there was considerable variation in the slag from day to day.

Wetting the ore before charging into the furnace was tried but with unsatisfactory results, and it was not until the ore was wet as it was being unloaded from cars to stock pile that this method was of much benefit. It was only possible to wet the surface, when once in stock pile, as the water would only penetrate the ore to a depth of a few inches. However, wetting at unloading was of considerable help and took but very little extra labor.

The use of the flue dust every day as made, by converting it almost into a mortar with water, charging at intervals during the day, putting it on the bell first and covering with the balance of the charge before dumping, has been the most practical solution of the dust problem up to this time, and is entirely satisfactory to some of the furnace managers using this method; but the majority of them feel that sooner or later a better way of using up the flue dust and reducing the amount made to a minimum will be found. Some experimental work has been done to try and solve the dust problem in a more satisfactory way. At one furnace a small heating furnace was built with a hearth about 5 x 8 feet, the furnace gas being used as the source of heat, and an attempt made to put the flue dust into a cinder. This not proving satisfactory, the effort was made to sinter the dust together into a cake or lump, but the experiment was unsuccessful.

Other methods of getting the dust into better shape for use have been suggested and will undoubtedly be tried sooner or later. One is to put the dust through a small cupola, using the screenings from the coke bins as fuel and running it into a cinder or silicate of iron; another is to put it into briquettes. This would entail considerable expense in erecting a plant, but it would undoubtedly put the flue dust into the best possible form for use.

This last method will finally be resorted to unless changes in the furnace itself, or method of working these ores, shall reduce the flue dust made to a point where it will give no trouble.

Before the use of Mesabi ores, severe top explosions occurred from time to time at the larger modern furnaces, where rapid driving and large outputs were in order, but not much was heard about them. These explosions were attributed to slips, this explanation being based on the theory that when the column of stock in the furnace slipped suddenly after hanging, air was sucked in at the top of furnace, which, mixing immediately with the after-rush of gas, resulted in an explosion, generally wrecking the top hamper and injuring some of the workmen. After the Mesabi ores came into general use, these explosions were more frequent, and furnace managers generally began to study the matter more closely. Mesabi ore was blamed at once, and possibly with good reason at that time. The caution with which furnace managers proceeded when first using these ores, brought about conditions that were at times perfect for an explosion. The use of too small a quantity of air, the lack of power to use enough at times, attended by the hanging and slipping, were often followed by an explosion, making the furnace manager wish he was in some other business, after contemplating the wreck. The best authorities have come to the conclusion that these explosions are not gas explosions but a deflagration of fine impalpable carbon in the furnace, the fine condition of the carbon being brought about when the furnace is slipping badly for some time. The constant slipping grinds the coke next to the walls to a fine powder; this becoming intimately mixed with the fine ore, then, perhaps, rushing ahead by a slight slip to a point in the upper zones of the furnace where it is out of place, results in rapid reduction, the fine ore giving up its oxygen to the fine carbon, causing the deflagration of enough to create a severe explosion.

With a modern plant with sufficient power, explosions occur no oftener, nor are the conditions for them brought about easier with Mesabi ores than with ordinary hematites; therefore it is unjust to lay the blame of these explosions to the fine ores.

The use of Mesabi ores is now general in the districts in which lake ores are depended on. A large concern operating a number of furnaces uses not less than 25 per cent. in any of its furnaces and as high as 58 per cent. in

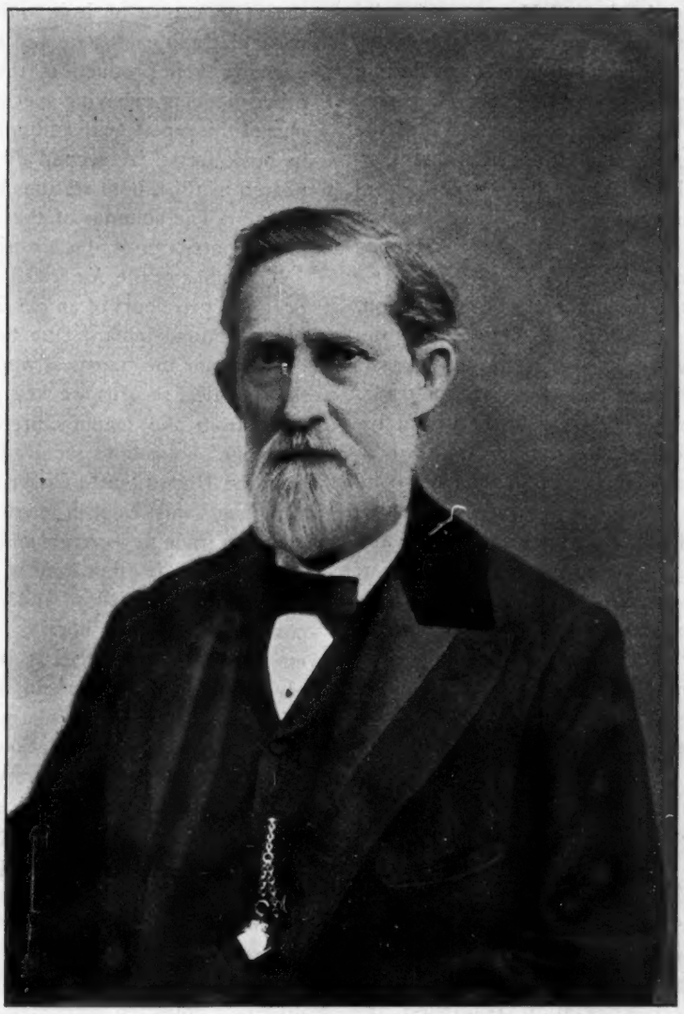
one. Several valley furnaces have as high as 50 per cent. and over in their mixtures and are doing better work than ever before in their history. One furnace in the Pittsburg district, 75 x 16 feet, is using ⅝ Mesabi ore in its mixture and has done remarkable work, averaging for the past few months 250 tons of iron a day, on considerably less than 2,000 lbs. of coke to the ton of iron. The percentage used by furnace men in their mixtures will increase, and before very long the bulk of ore used for the manufacture of Bessemer iron will come from the Mesabi range.

The ease with which these ores reduce is to-day bringing about developments in blast furnace practice, along the line of higher power, lower fuel, more uniform iron and a greatly increased product; and no manufacturer can afford to keep them out of his mixture on account of trouble in learning to use them, or on account of their fineness, for sooner or later he will be forced by circumstances to use them in larger quantities on the start, than if he were keeping up with the times and using them now as a portion of his mixture, thus getting familiar with their characteristics.

TWENTY-TWO YEARS OF VALUABLE SERVICE.

BY WM. M. SWEET.

The American Iron and Steel Association is the successor of the American Iron Association, which was organized in Philadelphia on March 6, 1855, and its office established in that city. A vast amount of valuable statistical information relating to the iron industry of the whole country was compiled and published in the *Bulletin* of the parent association from 1855 to 1859, the first *Bulletin* appearing early in 1856. In 1859, the association published "The Iron Manufacturers' Guide to the Iron Works and Iron Ore Mines of the United States," compiled by the secretary, Prof. J. P. Lesley, a work of which the American iron trade stood in great need, and of which it had then and still has just reason to be proud. It contained about 800 printed pages and several excellent maps. On Nov. 16, 1864, the association, which had been in a dormant state owing to the Civil War, was reorganized and its name changed to the American Iron and Steel Association, to meet the new conditions created by the advent of the age



James M. Swank

of steel. The office was continued at Philadelphia. The new association, with an average membership of over 300 manufacturing firms and companies, has been in active operation from that day to this, a period of more than 30 years, and during 22 years of this time, beginning with Jan. 1, 1873, Mr. James M. Swank has been its secretary and either officially or in fact its general manager.

Mr. Swank had special qualifications for the work he had undertaken. Born and reared in Western Pennsylvania, he was familiar with the development of the iron industry in that important field of iron production. His home was at Johnstown, an iron town. A journalist by profession, having established the Johnstown *Tribune* in 1853, and an adherent of the old Whig party, and having also inherited a liking for public affairs, he had become familiar with the country's tariff legislation and with the policy of protection to home industry. He was personally familiar with the disastrous effects upon our iron industry of a purely revenue policy from 1846 to 1861. Parting with the *Tribune* in December, 1869, Mr. Swank passed the next three years in Washington, first as clerk of the Committee on Manufactures of the House of Representatives, and afterwards as chief clerk of the Department of Agriculture. In December, 1872, he resigned the last named position to take charge of the work of the American Iron and Steel Association.

When Mr. Swank entered the office of the association, he was confronted with a difficult task. One of the principal objects of the association, as also of its predecessor, was the collection of statistics of the American iron trade. An immediate necessity was a complete list of the active iron and steel manufacturers of the country from whom only could accurate statistics be obtained. The list compiled by Prof. Lesley before the war was too antiquated to be of practical use, and later lists were incomplete and not of recent date. In the following month of November, the first edition of the now well known "Directory to the Iron and Steel Works of the United States" was published. Twelve editions in all of the "Directory" have appeared. In the same month, the first "Annual Report" of the new secretary, containing statistics of production, was presented at the annual meeting of the association. The "Annual Report" has since appeared regularly, 22 volumes in all having been published. The "Directory" has described the iron and steel works of the country and and the "Annual Report" has faithfully told what they have made.

The *Bulletin* of the old Iron Association, which, as has already been stated, first appeared in 1856, was published at irregular intervals, chiefly for statistical purposes. The American Iron and Steel Association continued the irregular publication of the *Bulletin* until Sept. 12, 1866, when the first number of a new series, to appear weekly, was issued. Mr. Swank found the weekly *Bulletin* in existence when he assumed charge of the office. The paper was, however, enlarged after he became its editor. Its principal characteristics, under his management, have been the presentation of statistical information additional to that contained in the "Annual Report" and the discussion of tariff and other public questions of interest to the American iron trade.

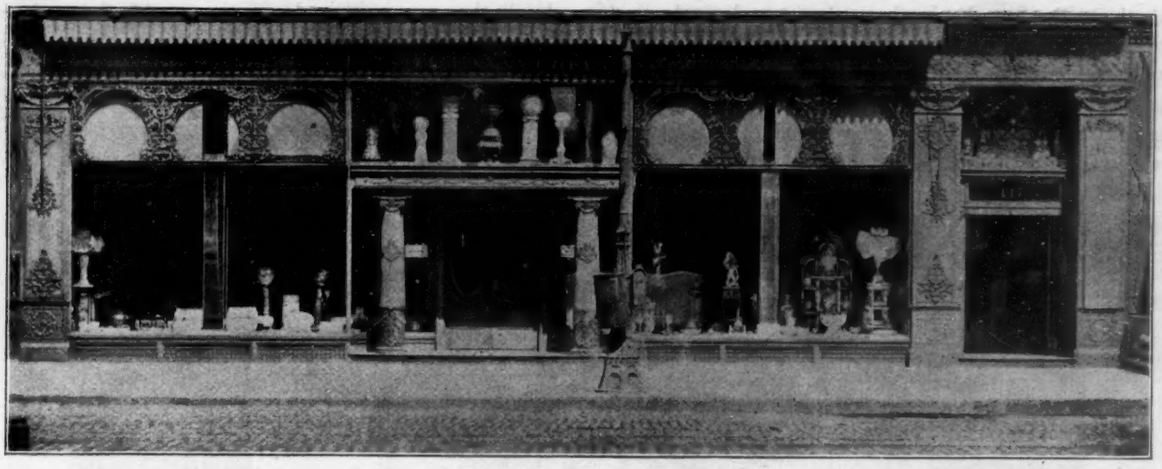
The work of the association in behalf of the protective policy and in behalf of adequate duties on iron and steel, has always received the earnest and active attention of its officers, and into this work Mr. Swank entered with zeal and enthusiasm. The friends of Protection in Congress have relied upon him for accurate information whenever a tariff was under consideration. In addition to the discussion of the tariff question, which he soon made a leading feature of the *Bulletin*, he presented in the "Annual Report" for 1876, a carefully prepared history of the industrial policies of Great Britain and the United States, and in 1877 he issued "Hold the Fort," the first of a series of tariff tracts of which many millions have been printed and gratuitously and systematically distributed.

It has been a labor of love for Mr. Swank to do what he could to preserve from oblivion the achievements of the pioneers in the manufacture of iron and steel in our country. In 1878, he published in book form an "Introduction to a History of Iron Making and Coal Mining in Pennsylvania." Having been selected by Gen. Francis A. Walker to collect the statistics of iron and steel for the census year 1880, he accompanied his final report in 1881, which contained these statistics, with a historical sketch of the manufacture of iron and steel in all countries and particularly in each state and territory which had been engaged in their production, the work of the colonial and other pioneers receiving special attention. The historical part of this report, with additions, was afterwards published in book form. A second edition, greatly enlarged, appeared in 1891, both editions being entitled, "Iron in All Ages." The columns of the *Bulletin* have also contained many contributions of a historical character.

The office of the American Iron and Steel Association occupies two floors of an old-fashioned building in the old part of Philadelphia. One floor has been set apart exclusively for the statistical work of the office, and here all the statistical records are kept, including the original reports from the manufacturers; also all statistical and scientific publications received from foreign countries and from the United States Government. Files of the leading American and English engineering, financial, railroad, and iron trade newspapers and magazines are also kept on this floor. The other floor is devoted to the general purposes of the association, and on this floor there is a very complete reference library; there are also portraits of eminent living and deceased iron masters and relics of the early days of the American iron industry. The office is called upon to maintain a large correspondence in addition to the collection of information for its publications. Much of this miscellaneous correspondence is with statistical authorities in foreign countries.

The American Iron and Steel Association is an accepted authority in all countries upon the statistics, history and development of our iron and steel industries, but Mr. Swank has brought to the Association even a higher honor. He has established for it the reputation of absolute leadership in teaching the world the value of accurate and promptly collected manufacturing statistics. Not until he led the way had accurate and detailed statistics of any great manufacturing industry at home or abroad been promptly collected from year to year by any agency whatever. The British Iron Trade Association was not established until 1875, and its statistical methods were modeled after those of its American prototype.

Mr. Swank gives his personal attention to all the details of the office, and in this fact is found the principal reason why he is so seldom able to visit the widely scattered iron districts of the country. He sees that letters are promptly answered, and he likes to send the *Bulletin* to press himself. He insists upon good proof-reading and knows the difference between good and bad printing. His clerks soon fall into his methodical ways, and he gives them full credit for work well done. The association has never done better work than during the eventful year which is now closing.



STORE FRONT OF BRONZE.

DECORATIVE IRON WORK.

The Product of the American Artist-Blacksmith.

BY W. H. ECKMAN.

Rust has destroyed every vestige of the handiwork of the blacksmith of antiquity. This is presuming that there was such a blacksmith, and that he had fashioned anything in iron which this relentless and irresistible foe could assail and destroy; a presumption not fully sustained by either written history or transmitted tradition. The stories of the use of iron in the early ages are little more than apocryphal; we may accept them and find a gossamer thread of evidence upon which to pin our faith, or we may reject them wholly without qualms of conscience.

Whatever of uncertainty may exist, however, as to the use of iron when the world was young, we are assured beyond peradventure that its use structurally, either in a utilitarian or decorative way, was not among the early arts; that in fact it found no place in structure prior to the beginning of the Christian era. Quite recent discoveries give some color to its limited use by the Romans. Neither sacred nor profane history mentions any more pretentious work than a bedstead, a war chariot, a column and a statue; and in no building or structure erected by pre-historic man has there been discovered any indication of its use, or a structural condition requiring or presupposing its use.

In weapons of offense and defense, the use of iron antedates by long centuries its application to useful purpose. In the early history of the metal it is associated with the arts of war rather than with those of peace. Strength, allied to violence, turmoil and bloodshed are suggested by every reference to iron to which any beauty of form or embellishment had been imparted by the early smith. Armor, shields, swords, javelins, battle-axes and all the murderous panoply of the soldier and the equipment of the chamber of torture, used so lavishly and persuasively by layman and churchman in the "good old days," were made of iron. The soldier's outfit was beautified and embellished with such elaboration as to impart a fabulous value to single pieces. Scions of royalty are said to have wrought, tempered, chased and inlaid with gems and precious metals, the swords they themselves wore and used, giving to them names and titles and consecrating them to righteous use, as they understood the term. So exquisitely were some of these weapons fashioned and beautified that we are forced to the conclusion that the artist and the smith were distinct individualities; that the artist-blacksmith, as we know him today, can trace his ancestry no farther than the Middle Ages.

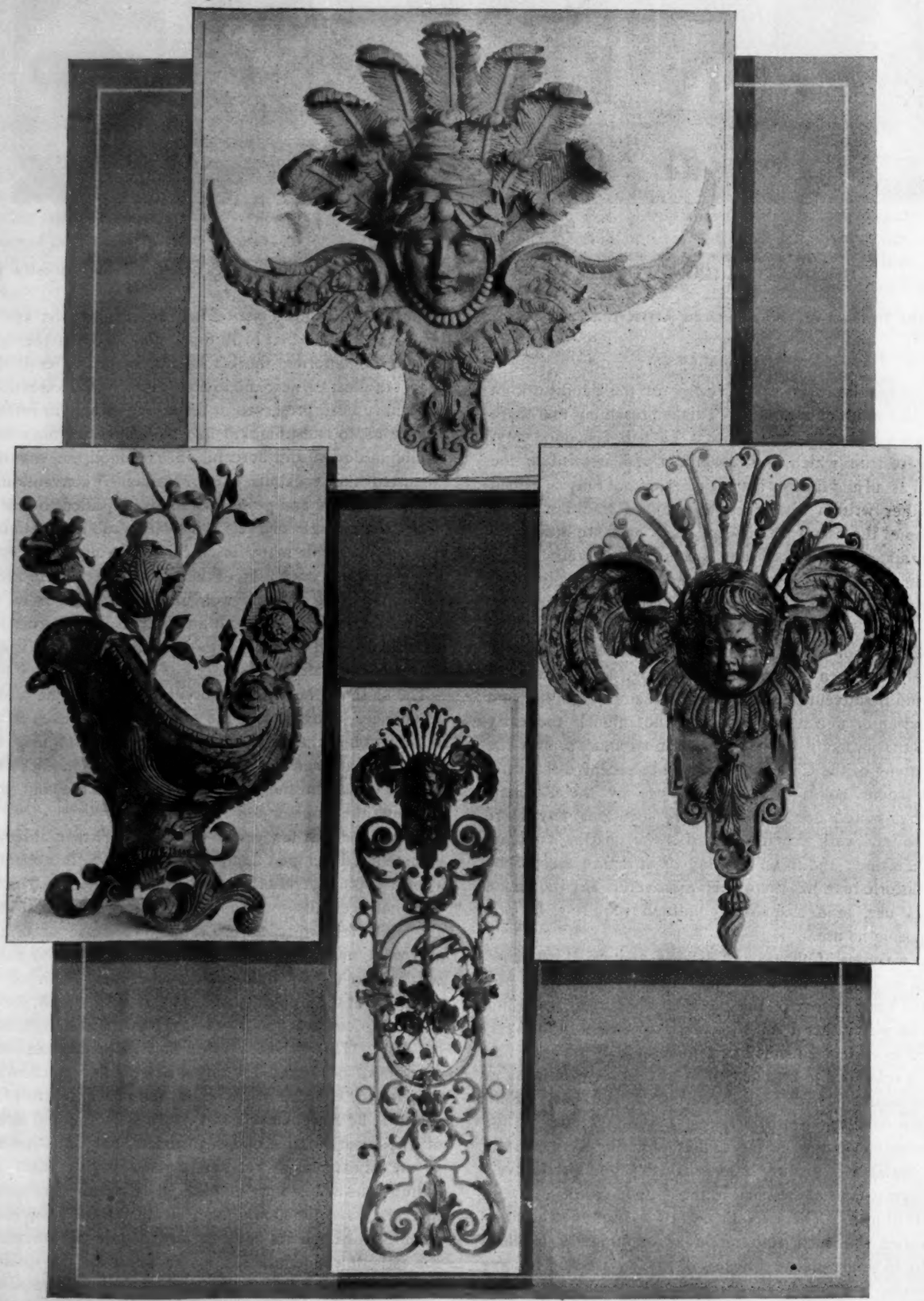
During that brilliant period, which includes the era of the Renaissance of Art in Europe, notably from the 13th to the 17th centuries, the blacksmith made his craft the subject of most earnest and loving study. Of his creations many have been preserved in the museums and in private collections, to attest his skill and to incite to emulation. Prolific in design and forceful in execution, he virtually exhausted the vocabulary of ornament; conventional, natural, fantastic and grotesque forms appealed to him in turn. He wrought marvels in which a sublime patience in execution is, in many instances, in stronger evidence than a truthful conception of the tenets of art. He loved his art, weaving into its web and woof a vigorous individuality, which gives to it a charm all its own, disarming criticism and winning a deserved meed of credit as a master of his craft.

The close of the 17th century marks a decline and a decadence. Having run the gamut of form, even to the introduction of the unpoetic pig into a grille of iron, the blacksmith allowed the fire in his forge to smolder; the file, the chisel and the graver, all used upon the cold iron, replacing the hammer and anvil.

Within the past few years—scarcely more than a decade—there has developed, both in Europe and in this country, a remarkable revival of interest in the subject. This revival has been the more notable in this country than in any other for two reasons; primarily because decorative iron work was not among the arts practiced by our native smiths prior to this time, and further by reason of the evolution of the iron or steel beam, out of which sprang "Chicago construction," making possible the high office building. Thus it has occurred that the American artist-blacksmith has found not only a new but a much wider field for the exercise of his craft, and it may be truthfully said that he has achieved, not only a success equal to that of the most notable of his ancestors, but outstrips him in the adjustment of relative parts and the exact and harmonious adaptability of his equally artistic conceptions to every given function. Nor has this frank concession to modern exigencies been in any degree detrimental to the esthetic element in his work, as in all the qualities constituting good design the modern is quite the peer of the medieval smith.

The high office building has not only afforded our smith the opportunity, but has presented a problem to be solved only through his instrumentality; the elevator equipment, the displacement of wood and marble by the more graceful, pliant and space-economizing iron are in point,

while the grille, from having been almost exclusively used in the church and cathedral, is now being set up in secular temples to guard the money bags of commerce and trade, as in its earlier use it had been at once the reliquary and ornament of the church. The massive and gloomy corridors of the public and commercial structures of 20 years ago have given place to light and airy passage-ways, and this is largely due to the substitution of ornamental iron for other material, as a study of any one of the more modern, up-to-date structures will show.



The cuts accompanying this article illustrate more clearly than any written description could, the perfection attained by the American artist-blacksmith in producing ornamental iron,* giving to iron, which in itself is the antithesis of poetic sentiment, a rare beauty, enhanced by the surface treatment known as the Bower-Barff rustless process, whereby the surface of the metal treated is converted into red oxide of iron (rust) which in turn is reduced to the black or magnetic oxide, closely resembling

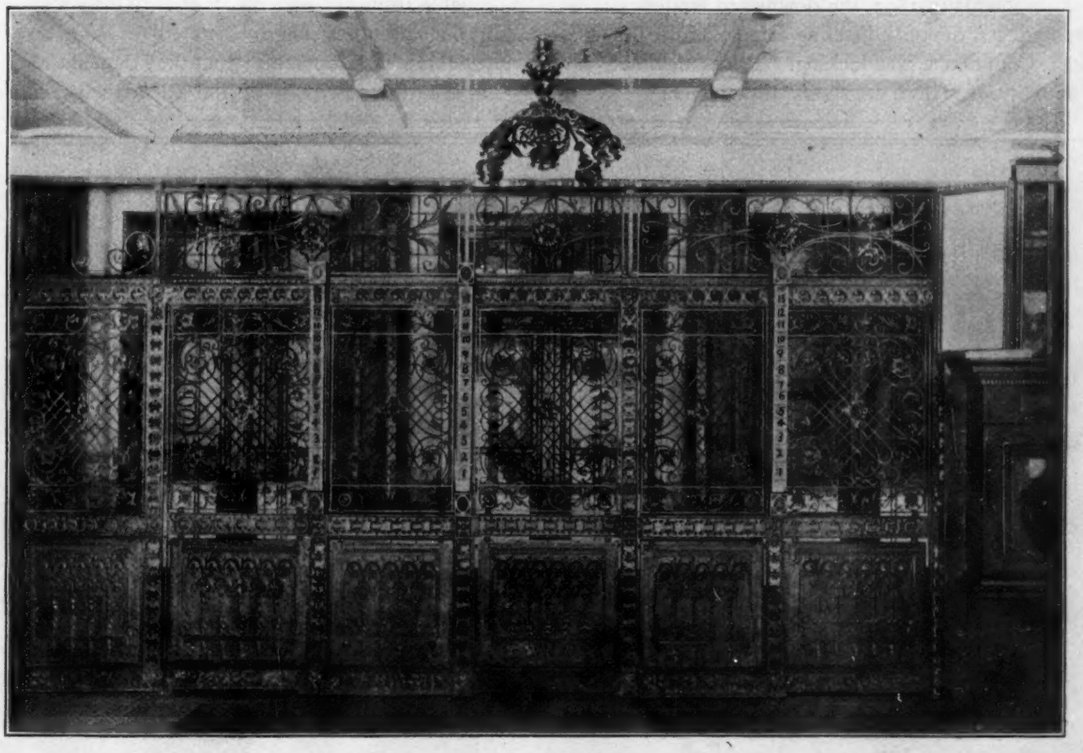
*The term "ornamental iron" as used in the Architects' plans and specifications for buildings, embraces all decorative work in metal, whether of iron or brass, bronze, etc.

an enamel and impervious to moisture—practically rustless.

The large cut, shown on page 18, presents some of the more prominent details of a monumental gateway, which with its companion side gates and fence now forms the principal entrance to the grounds of Gen. Joseph T. Torrence on Lake Shore Drive, one of Chicago's finest residence streets. This gateway is the largest, as it is the finest, example of hand-wrought iron work in the country, while the design embodies some features of the Rococo in combination with French Renaissance motives, the ensemble is a dignified and pleasing expression of independent thought. It is an American product, in the best sense of the term. The panel is an excellent example of what is technically known as "hammered leaf work."

An elevator inclosure is also shown, the upper panels of which are in wrought iron, hammered leaf work. The lower panels are the framing, are in bronze, the combination of the two metals being very pleasing to the sight.

The cut at the head of this article is from a photograph of the store front of Burley & Co., on State street, Chicago. In this, iron gives place to that monarch among the metals applied to decorative use—bronze. The entablature beneath the cornice, with its embellishment of garlands and wreaths, concealed in shadow, except that portion over the pilasters at the right; the capitals and bases of the columns and pilasters and the ornaments on their face are in bronze, as is also the highly ornate framing of the upper portion of the two show windows and the entrance doors.



The crowning ornament of the panel is shown, enlarged, at the right in the plate. The child's head as well as the mask with the feathered head dress above, which latter surmounts the gateway, is hammered out of a plate of Swedish iron three-eighths of an inch in thickness by the use of a peen hammer and a cushion of lead.

The beautiful scroll piece bearing the number "1919" is from a transom grille in hammered leaf work. The richly foliated scrolls and the interlacing of the members bear witness to the deftness and cunning hand of the smith, while the graceful trend of the lines, flowing out of and supporting the cartouche bearing the number, attest the clever designer.

The illustrations used are from photographs taken by the Winslow Bros. Co., of the product of their large plant in Chicago. From a small beginning, less than 10 years ago, the business of this company has grown until an entire city block scarcely suffices to accommodate the works, which give employment to from 600 to 700 skilled workmen. This rapid growth fairly measures the stride of the artist-smith in this country in the last quarter of the century, and the product of the works as fairly indicates the rapid assimilation of the best thought of the master smiths in the most brilliant era of their activity, the selection of the best, the fearless introduction of innovations and the skillful application to existing conditions.

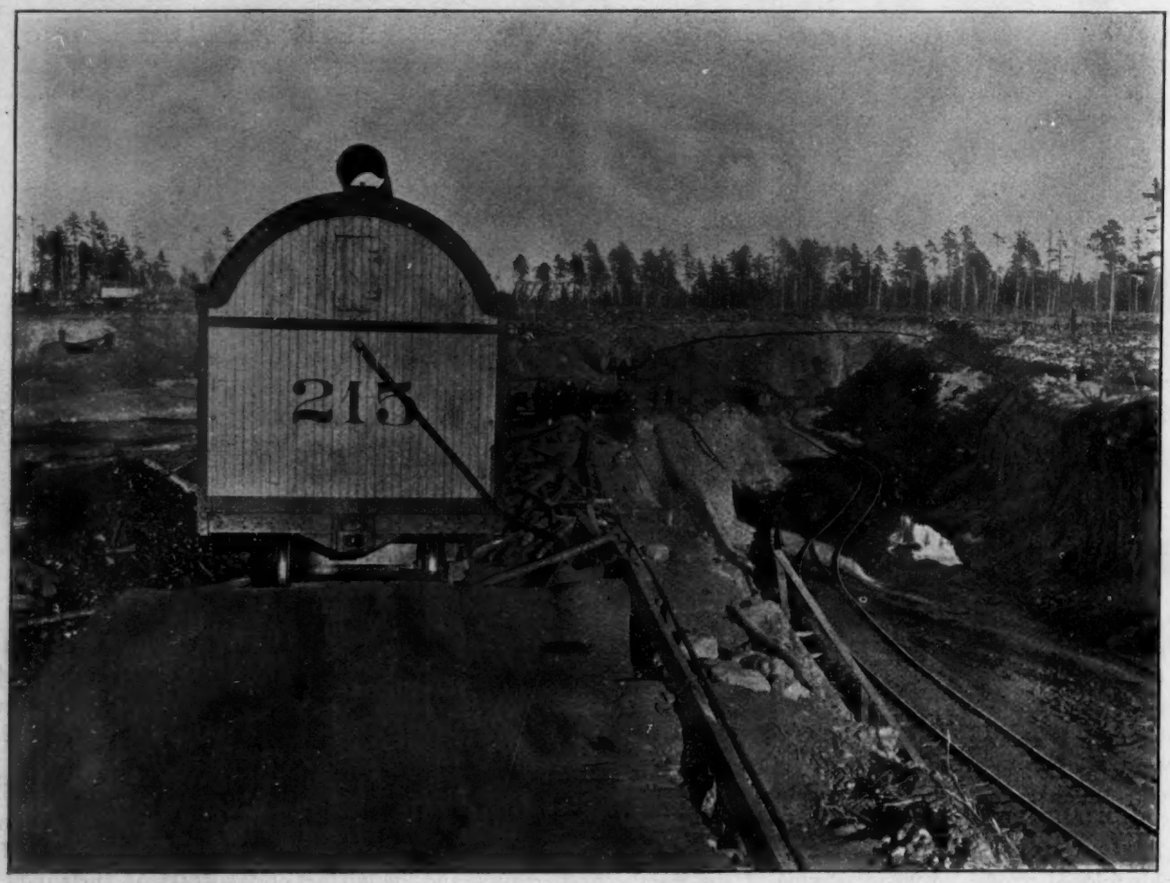
MESABI MINING COSTS.

Predictions Compared with Actual Results.

BY H. V. WINCHELL.

The year 1892 was a prosperous one for the iron industry. The volume of business was large and prices were fair, although lower than in any previous year. More ore was mined and shipped from the Lake Superior iron ranges than in any other season, before or since, and a larger number of laborers and miners employed to handle it. Although good wages were paid and the demand was nearly equal to the supply, the tendency of prices was downward. During this season Bessemer ore sold at $4.50 to $5.50 per ton on Lake Erie docks. With the close of shipments in 1892, the downward tendency rapidly increased. A depressed feeling came over the operators in iron. Confidence was lacking. Prices declined with great rapidity.* There was very little demand for iron products, raw or finished, and unsold stocks rapidly accumulated.

The causes for this condition of affairs were various, and not confined to the iron industry in their origin or effect. The general financial depression which was felt in Europe as well as in this country, was not the least influential of the conditions operating to produce this stagnation in business. Having fallen into the hands of so-called tariff reformers, who displayed almost daily their lack of harmony among themselves, and whose zeal in their reform evidently knew no bounds, it is not to be wondered at that capital sought a hiding place to await more settled times. More direct in its effect upon the iron industry and of far greater duration than financial depression or the uncertainty of tariff legislation, however, was the discovery during the year of the Mesabi iron range. In spite of the unprecedented demand for iron ore the older ranges had no difficulty in meeting all requirements. Indeed, more ore was piled up on the Lake Erie docks at the close of the season of 1892 than at any previous period in the history of the Lake Superior region. Under such conditions the discovery of untold millions of tons of soft ore tributary to these same docks and the same trade could not but be serious or absolutely ruinous to many of the old range companies. Such a depreciation in the value of mines and mining stocks which were earning a good dividend, as followed on the heels of this discovery, has seldom if ever been witnessed in this country. In view of the probable results of such discoveries, it is no wonder owners of mines on other ranges hesitated to believe the reports of the new developments; that they denied the probability and then the possibility of the existence of such beds of iron ore; that they accepted as true the biased reports of those who came to the new range at an early date with a fixed determination to find nothing of any value there, and made their reports accordingly.



OLIVER (MESABI MOUNTAIN).—South cut looking east. Aug. 10, 1894. One steam shovel seen in foreground, one in bottom of cut, and one in the north cut at left of the view. Pen line is drawn at top of ore.

Almost incredible, on the other hand, that men of experience in the iron ore industry, who had seen one new range after another discovered and developed, and who were heavily interested in iron mines, should have been so short-sighted as to refuse to accept the opportunities repeatedly offered them of securing holdings in the new field, thus recouping themselves for the losses certain to be sustained in their old range mines if the reports of the new range had in them even a fair quota of truth. What a commentary on the blindness of human nature, that the greatest iron range ever discovered should have been

* It is, perhaps, unnecessary to say that in 1894, Lake Superior Bessemer ore sold for $2.25@$3.00 in Cleveland.

disregarded by those best able to appreciate it and avail themselves of its value until investors from other parts of the country and other branches of industry should have acquired possession of its greatest bonanzas—if we may thus speak of iron mines. It could not have been for lack of information of the real condition of affairs. The mines were open for inspection. The daily papers called attention to them in startling headlines and long accounts, inaccurate and exaggerated to be sure, but having evidently a basis of fact. The owners of the newly discovered mines sought in vain for assistance to develop and equip them, in Cleveland, Chicago, Pittsburg, and other headquarters of the iron trade. *The Iron Trade Review* contained conservative and trustworthy accounts of the individual mines and of the range in general. The Geological Survey of Minnesota published a report giving analyses, mine sections and descriptions of operations and developments. Still the principal iron ore merchants refused to be convinced. Many old range papers devoted themselves to attacks upon the Mesabi and misrepresentations of its

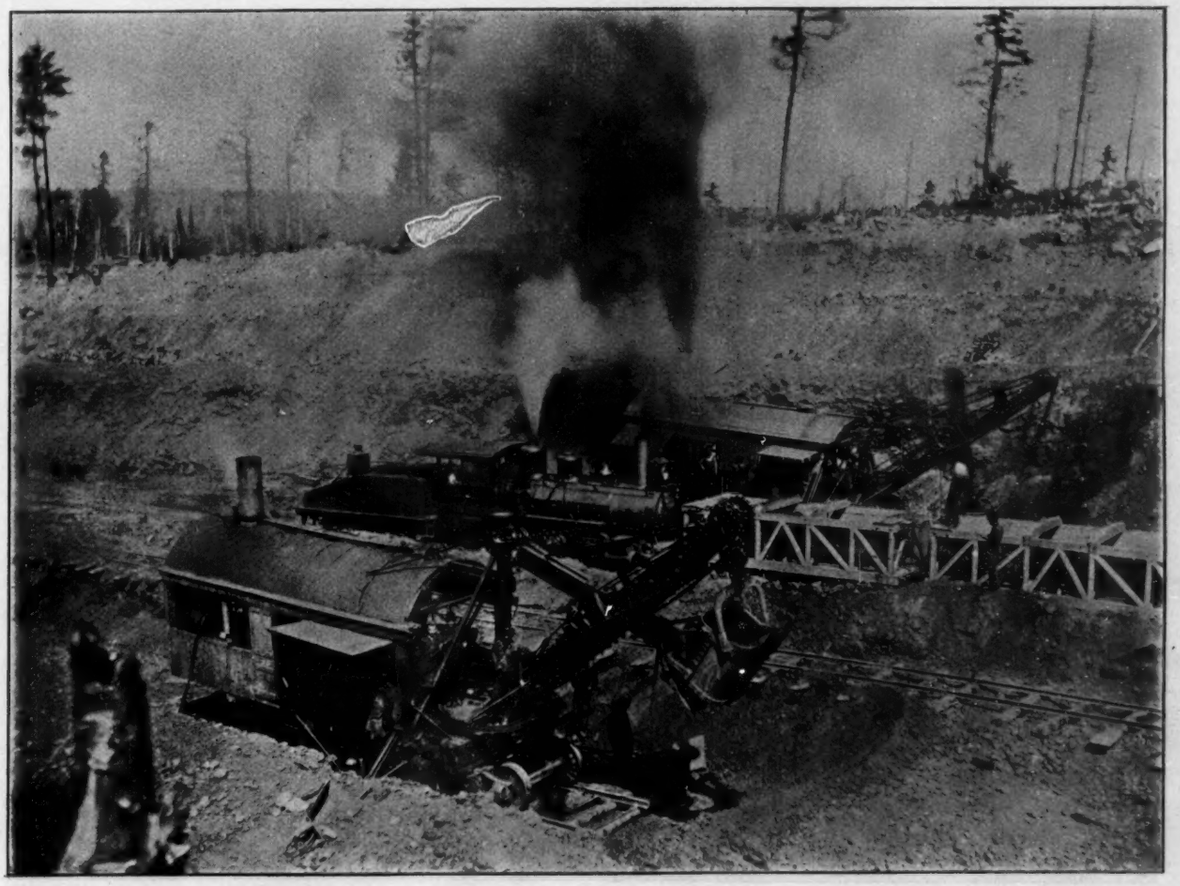
but it is plain that the most of the mines will be worked as open pits, with the surface stripped off. * * * * When the surface is removed the ore is practically a huge stock pile containing in some instances several millions of tons. At the maximum cost of mining this by hand and in hard ore the cost of stripping and placing ore on cars is 48 cents per ton. The minimum cost at the figures given above is 11½ cents. The average is about 29½ cents. But as there is more soft ore than hard the average may be expected to be about 25 cents. The cost of timbering alone in many mines on the south shore of Lake Superior exceeds the total cost of mining millions of tons of ore on the Mesabi.

In the geological report published the same year, the above estimate was quoted, and the following remark added:

Different methods of mining will vary in expense. The above estimate is for mining by steam shovels and stripping off the surface. If the method of underground mining is adopted the cost will exceed the figure given above.

Again:

The approximate cost of the ore delivered in Cleveland will be from $2.55 to $3.45. * * * If the large amount of Mesabi



OLIVER (MESABI MOUNTAIN).—North cut, looking north. Aug. 10, 1894. The shovel in foreground and track just north of it are for stripping. The train and shovel north of it are taking out ore.

actual condition. Some of the most influential of the Eastern mining journals gave room in their columns to erroneous statements, or even went so far as to state editorially that the ore on the new range was low in iron and high in phosphorus, and warn their readers against investments in the worthless stuff. Statements made by the writer were ridiculed, and estimates of the cost of production of this soft ore were declared to be "visionary" and "absurd." In articles published by the writer in *The Iron Trade Review* in the spring and summer of 1892, the following statements were made:

It is not to be supposed that there will be only a single method of mining here. Different men will have different ideas, and different properties will present different problems;

ore made suddenly available should force the price down to $3.75 per ton, there would still be a profit for the average Mesabi mine operator. * * * * The price of Bessemer ore will tend to be lower rather than higher, and Mesabi mine-owners may well be congratulated that to the excellent quality of their ore is added the combination of great abundance and advantageous situation for very cheap mining.

Analyses were given of the ore from twelve Mesabi mines, the average of which was 61.05 per cent. iron, 6.18 per cent. silica and 0.054 per cent. phosphorus. Later it was claimed that the ore shipped would average still better.

Let us now consider the actual results, at the end of two and a half years. In 1893, there were 684,194 tons

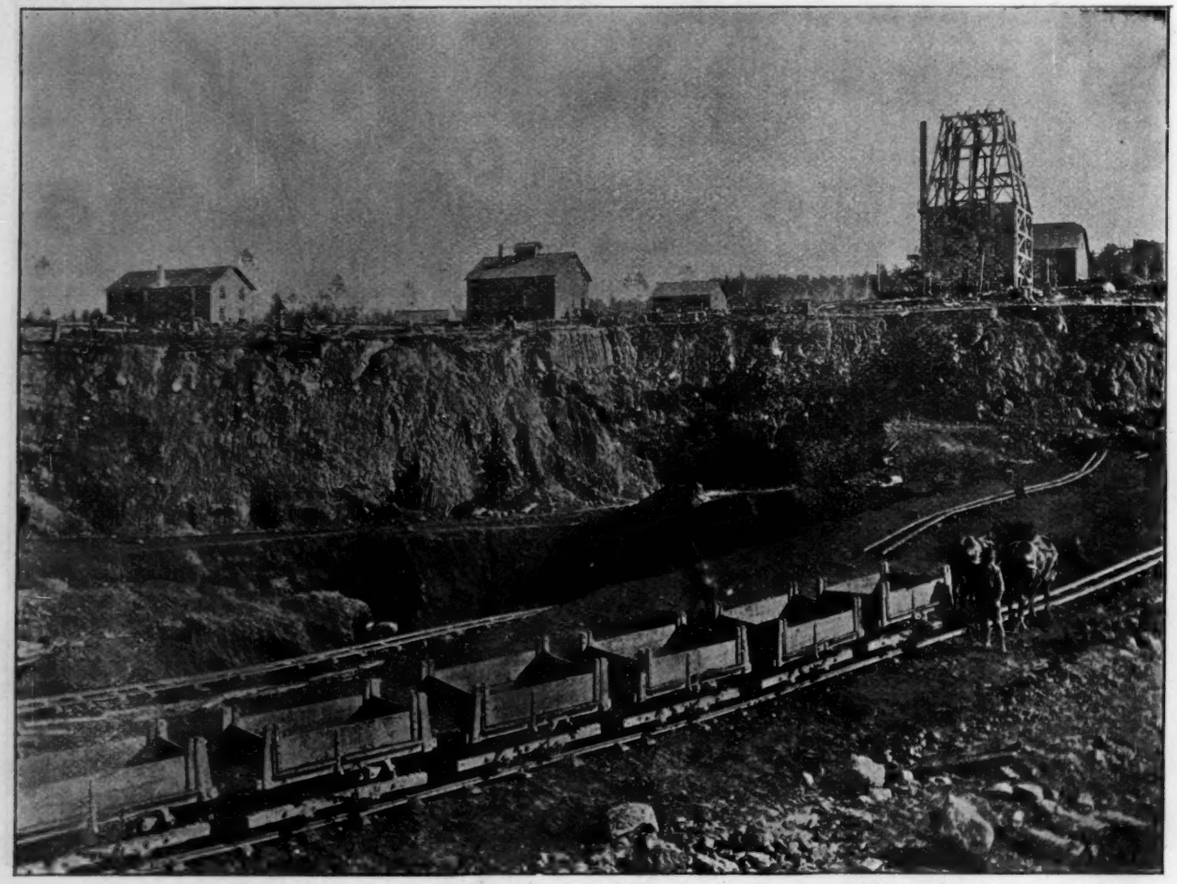
of ore produced from the Mesabi. Of this about 50 per cent. was Bessemer and above 62 per cent. in iron, and the average for the year was considerably above that predicted. In 1894, the shipments have been as given below:

Mine.	*Product.*	*Royalty.*
Auburn (Iron King)	107,865 tons	30 cents.
Biwabik	90,023 tons	50 "
Canton	211,841 tons	5 "
Franklin	223,399 tons	0 "
Hale	23,017 tons	20 "
Minnewas	2,140 tons	25 "
Vega (at Eveleth)	5,268 tons	... "
Missabe Mountain (Oliver)	505,955 tons	50 "
Mountain Iron	574,000 tons	0 "
Norman	38,066 tons	25 "
Total	1,781,574 tons	

Of this, probably not more than 40 per cent. was strictly Bessemer, although the iron content probably ran above 62 per cent. Three-quarters or 75 per cent. of it was mined from mines that have been stripped, and the mining cost was undoubtedly less than the maximum figure given in 1892 ($0.48 per ton). Indeed, it is probable that the average mining cost on the Mesabi, underground and open pit both included, has not exceeded this figure, if we charge against the ore mined this year only the proportion of dead work charges which it should properly bear. Moreover, it is quite certain that, even under the disadvantages under which experimenters in new methods of mining always labor, if the dead work is apportioned over the ore which it opened up, the average cost of open pit mining has not exceeded $0.25 per ton the past year.

It is not necessary to take this statement without verification. Any one can arrive at approximately correct results after an inspection of the operations at the mines. Let us suppose a case applicable to any one of half a dozen mines on the Mesabi. The surface is 30 feet thick and the ore 100. We have then about 8 tons of ore uncovered for each yard of surface stripped off. Stripping contracts are now being made for 40 cents per cubic yard. In other words, the stripping charge on the ore uncovered is 5 cents per ton.

After having stripped the ore it is excavated from its bed by one of two methods. The first method is by steam shovels which load directly into the railroad cars, as seen in the illustrations of the Missabe Mountain mine. For this method, rails, steam shovels and locomotives are required, as well as a gang of men to move the tracks, keep them clear of obstructions, drill and blast down the ore. The second method is by milling the ore down through a winze or "raise" into tram cars which run to the shaft and are hoisted and dumped in the usual manner. Mining is conducted in this way at the Auburn (Iron King) as shown in the illustration, and at the Norman and Berringer. This method requires hoisting appliances, shafts, levels for tram-ways and tram cars; making the expense of equipment about equal to that used in stripping. The labor cost is somewhat greater in the milling process, and the fuel cost in the steam shovel process.



AUBURN (IRON KING).—Oct. 15, 1894. Mining by the milling system. Shaft house in right foreground. Open pit in middle of picture. Stripping train in foreground.

Assuming, then, that ore can be mined as cheaply, under equally favorable conditions respectively, by one method as the other, let us consider briefly the cost of steam shovel mining. One steam shovel, attended by one locomotive and a gang of 45 men, can load on an average 2,000 tons a day, provided cars are furnished as required; and can load 4,000 tons in case of an emergency. Wages

have varied from $1.15 to $1.50 per day. At the latter figure the labor cost is 3.35 cents per ton on an output of 2,000 tons. But as much time is lost in waiting for cars and breakages, let us call it 5 cents per ton for labor. One steam shovel and one locomotive together use about 50 tons of coal per month, or say $10 per day for fuel and oil. This makes a fuel cost of half a cent a ton. Powder for shaking the ore may cost two cents a ton, and incidentals two and a half. To sum up, the mining cost is as follows:

Stripping	$0.05
Labor	0.05
Fuel	0.005
Powder	0.02
Incidentals	0.025
Total	$0.15

The charge per ton for interest on investment will vary largely, depending on the output and the actual cost of development. It is not likely, however, that the average interest on the cost of getting a mine into shipping condition will amount to more than ten cents per ton on the ore produced. Basing our figures on actual operations, we thus arrive at the same average cost as was estimated before a ton of ore was shipped. The cost of underground mining is between 40 and 50 cents per ton.

The opinion is frequently expressed that the cost of mining will rapidly and greatly increase. Those who make this statement must be unfamiliar with the range. It seems more reasonable to think that mining is likely to be more expensive now, under the most favorable conditions, than it will be three or five years hence. Large amounts of dead work, costly explorations, new methods of mining, experiments with new machinery, training men to new duties, all these items of expense will be lessened rapidly. It is moreover not improbable that as depth is attained in the open pits, mechanical conveyors will be employed which will handle the ore with fully as great economy of power as now and with fewer interruptions. Those expenses which will necessarily increase with depth, such as pumping water, will be hardly sufficient to offset the greater economy and efficiency which are certain to come with experience.

The operations of the past year have shown that there is a wide difference in the quality of ore from different mines, and even from different parts of the same mine. A larger percentage of the Mesabi output has been non-Bessemer in 1894 than was the case in 1893. One reason for this is that certain mines, like the Biwabik, Berringer, and Minnewas, whose product is nearly all Bessemer, have made a much smaller output than last year. Another reason is that the non-Bessemer ore is usually at the upper part of the ore body and is first reached in steam shovel mining. This is true of the Missabe Mountain, and to a certain extent of the Mountain Iron, although the latter has to contend with sudden variations in the quality of the ore regardless of its position in the ore body. The shipments from these properties for 1895 and the following year will undoubtedly average better than those made during the past season.

BIWABIK.—East cut. Sept., 1894. Line drawn at top of ore, showing comparative thickness of surface and ore so far as cut into.

Some expressions of surprise and disappointment have been heard from Mesabi mine operators who do not find their ore equal to expectations based on samples taken from test pits. In some instances these operators purchased mines which had not been thoroughly explored and whose qualities were not known to anyone. In other cases the samples were not taken carefully and systematic-

ally. Knowing that the ore is in layers or strata of different color, physical structure and chemical composition, the sampler should have taken samples of each stratum separately, then in 10-foot sections in each pit, and finally a sample from top to bottom. Such sampling of any property having test pits enough to warrant its purchase would reveal clearly and unmistakably the quality of its ore. If there were not test pits enough it was not a difficult matter to sink more. Too many properties were sampled from the piles of ore thrown out of the pits, and not from the pits themselves. The result is only what might have been expected.

Many transactions have taken place in the past year in which a reduction of royalty has been effected. Some mines have been purchased in fee. Others have reduced the royalty for a cash consideration or because of an increase of the output guaranteed by the operators. In still other cases the sub-lessee has been eliminated by purchase or through failure to comply with the terms of his lease and its consequent forfeiture. There are but two mines now being operated under a sub-lease at high royalty, and it is questionable whether there is any profit in it at the present price of ore. It seems not improbable that there will be still further reductions in royalties. As fee mines increase in number it becomes more difficult for royalty mines to compete with them, so small is the margin between profit and loss. With a demand for Mesabi ore which is decidedly limited as compared with the possible production, it is plain that competition will be active and prices low. Even with a consumption of eight million tons of Lake Superior ore in 1895, there will probably not be a demand for more than 2,500,000 tons of Mesabi ore; while it will be generally admitted by those familiar with the range that there would be no great difficulty in producing 4,000,000 tons. The mines are able to make the output; the railroads could handle it, and there are ample dockage facilities. The only question about which there is any doubt is the available tonnage on the lakes. It is thus readily seen that the fee mines have the advantage, and since these are largely in the hands of the companies which also own the railroads the royalty mines labor under an additional disadvantage.

Contracts for large minimum output are unfortunate features of Mesabi mining. Under an obligation to pay for an excessive amount of ore each year, whether it is mined or not, the ore market is flooded and prices forced down below what is paid for the same quality of ore from other ranges. Indeed, until furnaces are so modified as to use a larger percentage of Mesabi ore in their mixtures, and until Mesabi producers stop cutting each others' throats, there will inevitably be this discrepancy in price. Old range producers have discovered that at present they are not obliged to enter into competition with Mesabi ores to such an extent as they feared. Their ore is in demand in any event, and they can ask a higher price than they have received in 1894. It is likely, therefore, that there will be a wider difference in price between established grades and Mesabi ore in 1895 than there has been in 1894. It is then only natural to expect that there will be so much economy in using the cheaper ore that such modification as is necessary to use 50 or 60 per cent. of it will be made in the furnaces, thus leading to an increased demand for these grades in 1896. Prices will then be more nearly equalized and Mesabi operators will perhaps be able to reap a profit where it is now impossible.

The amount of ore "in sight" on the new range has increased materially in the past year. New discoveries are made from time to time and the end is not yet. It is no exaggeration to say that there is now known to exist on the Mesabi at least 200,000,000 tons of iron ore. Of this probably not more than 40 per cent. is Bessemer. The disposition of the non-Bessemer ore is going to be a serious question. At present the market for it is daily growing more restricted. Complications will inevitably ensue, arising from the provisions of some of the leases and contracts already made. The only apparent means of utilizing these lower grade ores is by the perfection of some process of smelting without fuel—by electricity, for example. Such a discovery, while bringing about sudden and wide-spread changes in the iron industry, would be of great benefit to the country in general, as it would permit the manufacture of iron to be carried on in locations where fuel and iron products are costly, but iron ore and water power for the generation of electric power are abundant. If we may believe recent reports from Germany, the day for electric reduction of iron ore is not far distant.

To recapitulate: In 1892, Pittsburg, Chicago and Cleveland iron ore merchants scorned Mesabi mines; now they are purchasing them at high price. The ore is stripped and mined at a cost of 25 cents, or mined under ground for less than 50 cents a ton. Royalties on Mesabi mines are being reduced or entirely wiped out and high royalty operators must find it difficult to derive any profit from their mines at present. Mesabi ores will probably sell for considerably less than ore from other ranges in 1895; but there may not be so much difference in price in subsequent years. Although only a small percentage of Mesabi ore is used in furnace mixture at present, there will probably be a production of 2,500,000 tons in 1895, and, perhaps, 4,000,000 tons in 1896. A large percentage of Mesabi ore is non-Bessemer, and will never be transported any great distance for its consumption.

"Blowing in" a Furnace.

Starting a blast furnace was formerly an occasion of great importance to the community settled about it, and was naturally associated with more or less superstition. Some of the older founders would consider the presence of a female at the furnace when its preliminary charge of fuel was being lighted an evil omen, and any subsequent bad work would be ascribed to the innocent sister. *Per contra*, in later times the practice has often been to invite, as a compliment, the wife or daughter of a prominent officer of the iron company to light the fire when a blast furnace was starting on a new campaign. The older practice was to fill a blast furnace entirely with charcoal, lighting it at the top. When the fire had worked down to the hearth the tuyeres were inserted and the blast was applied, fuel being added with increasing quantities of ore and sufficient flux until normal working was secured. Finding that this resulted in a hot top and cold hearth, while the reverse was required for good work, furnaces were filled with charcoal, except the hearth into which kindling was placed, and, after lighting at the bottom, nothing was done until the fire had worked through to the top. Then fuel, ore and flux were added and the blast was driven into the furnace. Subsequently, particularly where mineral fuel was used, the hearth was filled with kindling, cordwood occupying the space up to the "bosh" or greatest diameter of the furnace; then came a large bed of coke or coal and flux, followed by more fuel, together with increasing quantities of ore, the blast being held in reserve until the mass was well on fire. Each of the methods described occupied days, and sometimes a week was consumed from the time of lighting to the application of blast, but later practice is to use the air from the engines soon after lighting to stimulate the fire, at first in small volume, increasing as indications favored such increase, so that a few hours now suffice for what it was formerly believed should take days. —[John Birkinbine in Cassier's Magazine.

ORES OF THE MESABI RANGE.

Quantity and Quality.—Methods of Mining.

BY RICHARD A. PARKER.

The advent of the iron ores of the Mesabi range of Minnesota into the already well-developed Lake Superior region, was at a time that every one connected with the older ranges felt was unpropitious. The supply of ores of both Bessemer and non-Bessemer grades was equal to a growing demand, and the enormous outputs of 1891 and 1892 showed that the old ranges could respond when called upon for still greater outputs. Its coming prior to a financial depression that left its mark upon many an industry, crippled others and annihilated still more, was an added blow to the older iron ore operators. In one respect, however, these hard times proved a blessing in disguise to those living within the influence of the boom that was the inevitable accompaniment of this wonderful development of iron ore. While values were exaggerated, men excited and the air rife with the gambling fever, the election of '92 even failed to stem the rush of men eager to "get in" and share the dollars that showered so freely; and not until early in '93, when it first became certainly known that the Democratic party had a majority in Congress sufficient to carry through their scheme for lowering the tariff, did the chill reaction come. Then the sense of impending disaster caused men to hesitate and debate, and the longer they did so, the more money they saved. It is almost axiomatic amongst those who have passed through two or more of these boom-fevers, that the vast majority of the stocks offered for sale are utterly valueless, and that they are bought only to sell, the final holder being the one to suffer. At the period when the boom was on, the conditions surrounding the land or mine had but little to do with the price or amount of stock to be sold, and those buying were as unfamiliar with the value of the products of the mine as men could well be of anything in common use—it was "buy on ten minutes option and sell before that time elapsed." When a more than usually cautious would-be purchaser had time to ask questions, the answers usually suited the disposition of the buyer. For instance, on the crowded steps of the Spalding, at Duluth, a doubting Thomas wanted to know if there was any phosphorus in the sample of ore exhibited by the stock vender.

"Phosphorus? Well I should say so. See that yellow streak" (pointing to a thin stratum of ochreish ore)—"why that's *full* of phosphorus!"

This was convincing to the inquirer, as his eyesight could not be doubted; and had he not been told that steel ore *must* have—or, wait a minute, wasn't it that steel ore must *not* have—phosphorus in it? At any rate, there wasn't time to find out which way this perplexing question should be decided. Another man under similar circumstances was told "there is all the phosphorus you want." Delightful naivete! Stocks that sold at par can now be bought for one per cent., and they are dear at that.

It is largely on account of such transactions that mining, as a legitimate business, has fallen into disrepute. The same scenes of wild speculation followed the development of the Menominee and Gogebic ranges, and it in turn was the forerunner of widespread trouble and disaster. There is a right way and a wrong way of doing about everything, except a kindly action, and the method above briefly sketched is not the accepted method whereby one should become interested in mining.

The Mesabi iron range extends from the Hale mine on the east to the Diamond mine on the west, a distance of about 50 miles, having a general trend south of west. Three railroads have access to its mines. The Duluth, Missabe & Northern was built by the Merritts originally for ore carrying, and runs almost due north from Duluth to the town of Virginia, with branches to the east (Biwabik) and west (Hibbing). The Duluth & Iron Range was the only road running near the range in the early part of 1892; on its way to the mines of the Vermilion range, a station called Mesabi was the debarking point and a stage or sleigh went west with the passengers to the mines or series of test pits. Today it has branches into the mines controlled by the Minnesota Iron Co., and several of the mines operated by others, but its tracks are confined at present to points east of Virginia. How long this progressive concern will be content to have its western terminus at this point, is problematic; but it is the belief of the writer that it will begin a westward march before many moons have passed. Late as it was when this company entered the field, today it is second to none in valuable territory owned, operated or controlled. The Duluth, Mississippi River & Northern, connecting with the Duluth & Winnipeg at Swan river, taps the western portion of the range, and with the D. M. & N. will carry away the ore mined from the neighborhood of Hibbing. These three railroads have large and finely built modern ore docks, the first named at Duluth, the second at Two Harbors, 24 miles northeast of Duluth, on Lake Superior, and the third at Allouez Bay, Wis., being a protected portion of the same lake and about six miles east of the D. M. & N. docks. This is the only iron range which is served by three independent railroads, each owning docks and full ore-carrying equipment; and when the range is operating on a scale commensurate with its ore reserves, it will give each road a large traffic.

There are at present six towns depending upon the ore industry on the range. Beginning at the east end and running westward they are as follows: Biwabik, supported mainly by the Biwabik, Canton, Rouchleau, and incidentally by the Cincinnati and Hale mines; McKinley, by the group of prospects still dormant, known as the McKinley group; Virginia, where are found the Oliver, Ohio, Lone Jack, Norman, Commodore, Franklin and a few others; Eveleth, supported by the Adams mine; Mountain Iron, where can be found the mine of the same name, including the Rathbun property; and finally Hibbing, near which are found the mines of the Mahoning Ore Co., Lake Superior, Sellers Ore Co. and the development made by Messrs. Longyear and Bennett, as yet idle.

The following are conclusive reasons to my mind, why Hibbing is apt to be the principal town of the range: The developed ore reserves that are contiguous to it are enormous, fully equaling, if not exceeding in size any known deposit elsewhere. The grade of the ore is uniformly high in iron, and while there is, as always, more or less ore of a non-Bessemer grade, the percentage of phosphorus is not so high in it but that the vast bulk of the ore may be used for mixing with a low phosphorus ore that will yield Bessemer pig metal, while the percentage of Bessemer ore found in this district is as large as at any point on the range. Further, the amount of labor involved in mining a ton of ore will be greater here than at any other central point, as there will be, in all probability, only one stripping mine of magnitude. The remainder of the properties will be operated as underground mines, which will involve a heavier force of men, with their supplies of food, clothing, housing, all of which constitute the elements of growth of a mining village.

One of the largest of the steam shovel mines shipped in

about six months work, 505,000 tons of ore, with a normal working force of 85 men; or at the rate of 40 tons per day per man for a six months season, counting 26 working days in the month. No other system of ore transference—it can hardly be termed mining—has ever shown such a high efficiency. And it is because machines replace men that here the number of men to be employed will be very large.

There are a few of the old range mines that have produced as high as five tons per man per day, but it is exceptional. Here, owing to the peculiar nature of the ore, that record has been reached, and will probably be maintained as a standard, underground, per-day output. It is hardly necessary to add, however, that the mine must be developed and well equipped before such figure can be reached.

The ore of the range is *sui generis;* there is nothing usually mined that resembles it in the hematite family. Elsewhere there are blue and brown colored ores, but the texture of the grain is markedly different. At times the ore has a grayish appearance and to the eye of one experienced in gaging the old range ores, it has a decidedly rocky look; it is fine, coarse, laminated, powdery, lumpy, wet, dry, light colored and dark, and in spite of these numerous vagaries, it is apt to run very high in metallic iron, much more so than an examination by the eye would seem to warrant. In many cases it is extremely uniform as to its phosphorus.* This range is not different from its predecessors in the amount of steel-making ores as compared with foundry ores. It has both grades, and, from an intimate knowledge of the grades produced, the writer is inclined to estimate the Bessemer ore at from 35 to 40 per cent. of the total. The past year has seen a large amount of non-Bessemer grade of ore sent to lower lake ports, that is unsold. This is largely due to the fact that it is apt to be the habit of deposits upon this range to have a covering of such ore overlying the Bessemer grade; so that in future years the amount of this grade is apt to be less than this season's output. This ore—practically all of it—comes from the open pit mines.

Where mines are to be operated in an underground system, owing to the sedimentary nature of the ore, small seams of Bessemer ore, say eight to 10 feet, can be mined as such, which, in either steam shovel or stripped milling† method, would be impossible owing to the admixture of the grades with each other, invariably tending to raise the phosphorus content—thus establishing an equilibrium between mining costs and quality of ores produced. Cheap steam shovel work is apt to produce a cheaper grade of ore, while the more expensive underground system enables the operator to produce a better, cleaner grade.

Of the working of these ores in the furnace, little need be said at present. The amount used depends largely upon who is using it and whether the furnaces are are interested in the success of the mines or not. Today the limits are placed at from one quarter to two-thirds of the ore mixture. It is an established fact that a furnace has run successfull for three weeks upon a rather high silicay Bessemer ore from one mine on the range, and made during that time an entirely satisfactory grade of iron without other trouble than a somewhat increased amount of dust (ore) in the catcher, over a normal mixture of ores that had previously been used. The fact that is of greatest weight in this connection, however, is that there are more furnace concerns interested in the mines of this range than any of the others of the Lake Superior region, with the possible exception of the Vermilion range—and it is hardly fair to include this one, as the number of shipping mines is practically limited to three—two of which are controlled by the Minnesota Iron Co. This would give color to the idea that in spite of the troubles that have arisen in the past, ways and means will be devised to utilize the vast store of ore that is daily becoming more accessible and proving its value as a storehouse from which to draw supplies for several decades to come.

It will be noted, too, that the furnaces that are now interested upon the range are considered by all competent to judge to be the most advanced in the furnace practice of this country—a practice that leads the world. These furnaces have at their disposal chemists and metallurgists, who regulate the working of the stack by the character of material supplied. At first, the ores gave trouble; but as their working was noted and their composition studied, expedients were devised. blast pressures increased and experiments made which have resulted in their successful use in intelligent hands. The "rule-of-thumb" furnaceman doesn't use these ores, for he doesn't dare.

The systems of mining that have been tried on the mines are various and interesting. The early history of the first steam shovel mine is familiar to all who are cognizant of the existence of the range. But one swallow doesn't make a summer, nor does one disaster in connection with the use of the steam shovel signify ruin to others who attempt its use. Given certain topographical conditions with not too heavy an overburden, and no method of working offers parallel advantages to it—enormous output at nominal expense, for a series of years, after which the ore remaining can be milled down and hoisted, thus affording a combination of the two of the more efficient systems of ore removal.

Again the old room-and-pillar system, so much in vogue upon the Gogebic range, has been tried in several of the mines, while a third has attempted to remove the ore by cutting and removing horizontal slices of ore 8 to 10 feet thick and allowing the surface to follow. This was a modification of the "North-of-England" system; and had the slices or cuts been taken from the top rather than the bottom, the chances are that it would have proved more successful. Surface sands followed the cracks developed in the ore, deteriorating its grade. With the top of the ore-body covered with slabs, poles, boards, etc., the surface sands, after the second or third cut, would not have been permitted to mix with the ore. This is a method well adapted to shallow deposits and is calculated to yield a greater percentage of the ore contained than by any other system.

The method of occurrence of the ore throughout the range is constant. The ore is underlaid by an erupted greenstone, which occasions the slight dip to the south so commonly found. Between the ore and greenstone a stratum of quartzite is found, which, being impervious, compelled the waters to remain above it, that effected the change of the secondary rock (taconite) into iron ore.* The extent of this alteration is variable—ranging from small, isolated, shallow, irregular-shaped bodies, to enormous masses, of great depth (one drill hole has been sunk 345 feet in ore) and continuous for great distances. One body of ore has a proven length of two miles and a

* The writer knows of two mines that ship a guaranteed 64 per cent. in iron and less than .04 in phosphorus. The season's average will be over 64 per cent. in iron.

† First used at the Duluth Ore Co.'s property, west of the Biwabik mine, by Mr. Chas. Whittlesey. It consists in stripping the surface covering of the ore, then milling the ore through mill-holes to tram-cars below—tramming to the shaft, where it is hoisted to the surface.

* The Geological Survey of the State of Minnesota has issued an admirable monograph, describing the ore, rocks and occurrence of the deposits, which is well worth reading by those interested in iron ore geology. It is written by J. Edward Spurr: Bulletin No. X.

quarter. The ore is seldom covered by rock, sand, boulders and hard-pan usually being the material through which the test-pits are sunk to reach the ore body. This fact alone accounts for the phenomenal rapidity with which the range has developed its wonderful resources, both by exploring and exploitation. Where water has interfered with the sinking of the test pits through the ore body, it has been customary to finish the exploration by means of a churn drill; as fast as the drill penetrated the ore, a casing pipe, of a somewhat smaller diameter than the chopping bit, was kept as close to the bottom of the hole as possible. When necessary the drillings were pumped up and run into a settling barrel when, after remaining for several hours to permit the settling of the lighter particles, the water was drawn off. It has been claimed that this method did not give correct returns; that the phosphorus in the ore body was apt to be higher than the returns from the sample. It is difficult to believe that this can be the case if proper precautions are taken to permit a settling of the material. Where the water is poured off too soon there is no doubt that the lighter portions, which are apt to carry apatite or the phosphorus-bearing material, will be lost and the resulting sample show too low a percentage of phosphorus. Again, care should be exercised when drying the sample that it is not allowed to get *too* hot, as in this case the error would be in getting too high a return in the percentage of iron. With careful attention to comparatively small details, there is no question but that a churn drill can be made to yield an accurate index to the true character of the material contained in the deposit. Another great advantage is the rapidity with which exploration may be systematically carried on, as the drill can cut from 5 to 15 feet in a day.

A final word as to royalties, and this outline sketch of the newest, and by far greatest, iron range of the Lake Superior region will be closed. In view of the decadence of the puddling furnace in this country and Europe, it is evident that foundry ores are to fall more and more into disuse until such time as necessity shall spur some inventive genius to the successful making of steel from ores now deemed useless for such purpose. It is equally evident, that until such time, ores of a Bessemer grade are to be in demand and for these a fair price should be paid.

The past year has been a disastrous one to the mining interests of all the ranges. On this new range, practically the only mines operated were those in which the operator owned the fee of the land. With two notable exceptions, both steam shovel mines, there was no leased mine operating that made a shipment fairly representative of its mineral reserves. In both the steam shovel mines the royalties were high, but not without some reason; there was practically no bonus paid for them with their proven wealth of ore. Both were regarded as capable of successful attack by means of a steam shovel; and herein lay a positive advantage, one a fee-owner is as much entitled to participate in the benefit of, as when one mine is practically all Bessemer ore and another non-Bessemer. The fee-owner in the former case enjoys this advantage over the latter, because the ore is worth more in the market. But where the mine has to be wrought in an underground manner, the margin of profit is apt to be very low for the next few years, and land owners are beginning to see that their interests run parallel to those of the operator. Forty cents a ton, a royalty that has been common in times past, must be reduced just about 40 per cent.; as royalty on non-Bessemer ores, 15 to 20 cents a ton, depending upon the grade, is as much as the market for some time to come is apt to warrant.

PATENT TOP FOR BLAST FURNACES.

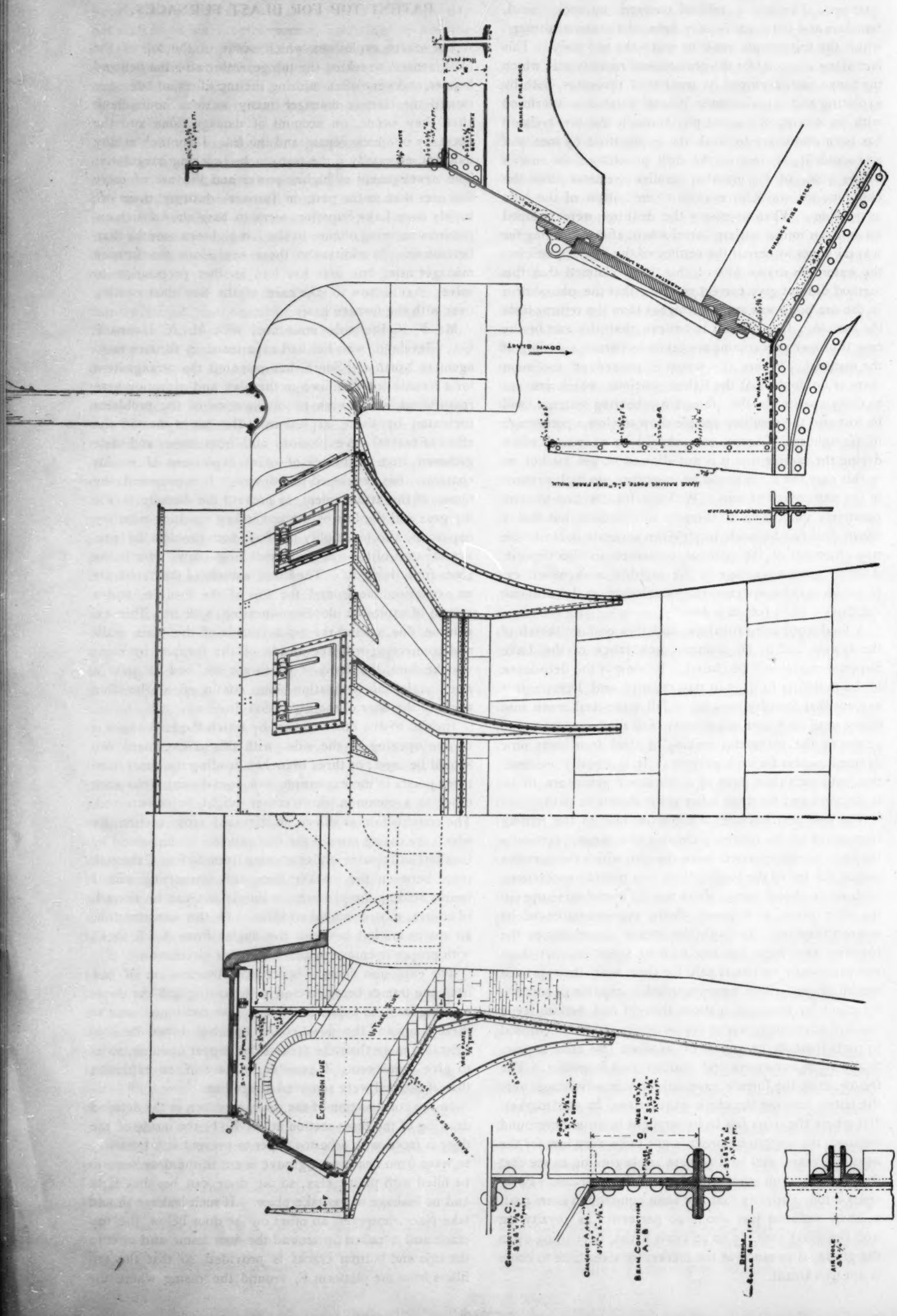
The severe explosions which occur in the top of the blast furnace, wrecking the top gear, throwing out bell and hopper, and very often injuring the top fillers, of late have caused the furnace manager many anxious hours, both after they occur, on account of damage done and the necessity of quick repair, and the fear of another at any moment, especially if the furnace be working irregularly. The development of higher power and the use of more fine ores than in the past, in furnaces drawing their ore supply from Lake Superior, seem to have shown such explosions occuring oftener in the last eighteen months than heretofore. In addition to these explosions the furnace manager using fine ores has had another proposition to solve; that is, how to take care of the flue dust coming over with the furnace gases.

Mr. F. B. Richards, connected with M. A. Hanna & Co., Cleveland, who has had experience in furnace management North and South, has patented the arrangement for a furnace top as shown in the plan and elevation here reproduced, with a view to solving some of the problems presented by these explosions. He has witnessed the effect of several top explosions and from these and data gathered from witnesses of other explosions of similar character, has developed this device. It is proposed, by means of this arrangement, to prevent the damage to the top gear and the loss of life and injury resulting trom top explosion, also to simplify the flue dust problem by preventing part of the fine ore which now blows over in the gases from doing so. The main features of the device are an expansion flue around the top of the furnace, and a system of explosion doors connecting with it. This expansion flue around the top is outside of the main walls and connecting with the inside of the furnace by eight up-take flues, the floors of which are inclined at quite a steep angle, this inclination being continued at the same angle in the floor of the expansion flue.

Instead of one down-comer, by which the rush of gas is to one opening at the side, with this arrangement two should be used; or three branches, leading the gases from three points in the expansion flue equi-distant from each other to a common down-comer, might be constructed. The construction as shown in elevated cross section, by which the casing around the flue and top is supported by brackets and double angles running from A, B to C through piers between the up-take flues, and connecting with I beams holding the platform, is simple and can be altered, of course, to suit individual ideas. In this construction, air spaces are left between the angles from A, B to C, with proper openings to admit of an air circulation.

The explosion doors of special construction are of cast iron, the frames being riveted to the casing and the doors opening into the expansion flue. The combined area of these doors and the down-comer opening should be considerably more than the area of the hopper opening, so as to give more vent, if possible, in case of an explosion than if the bell were removed altogether.

In the construction of the door, as shown in the detailed drawing of the cross-section at D, E, F, the inside of the door is faced with asbestos paper to prevent any tendency to warp from heat and a groove is cut in the door seat, to be filled with plastic clay, so the door can be shut tight and no leakage of gas take place. If such leakage should take place, however, an offset on the door below the top crack and a raised lip around the door frame and next to the side and bottom cracks is provided, so that the top fillers from the platform F, around the casing where the

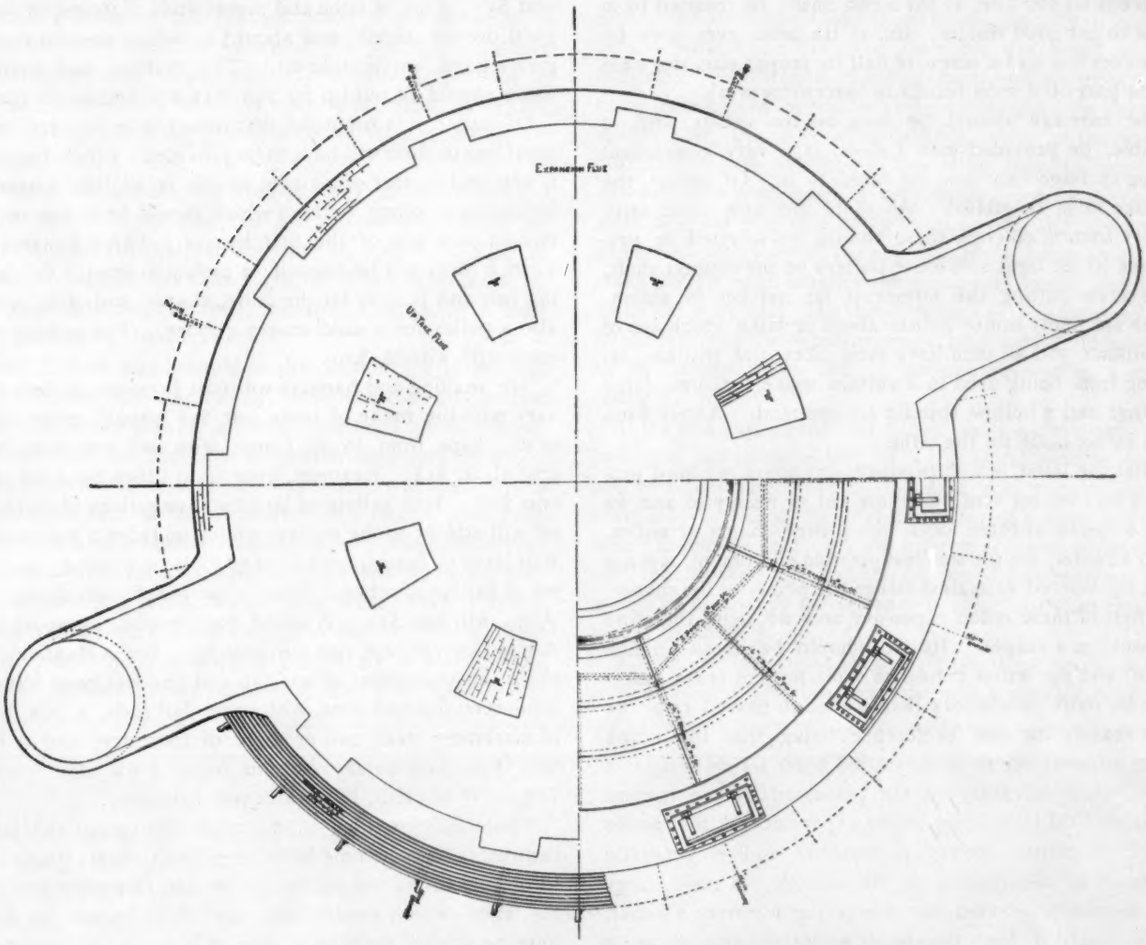


PATENT TOP FOR BLAST FURNACES.—SEE PAGE 27.

explosion doors are located, can stop any leakage with wet clay. These doors can be weighted so as to open at any desired pressure, by having a lug put on the door to hold a weight, and the hopper, instead of simply resting on the superstructure, can be safely fastened down.

With this top, the dissemination of gases after leaving the stock line, will be nearly equal in all directions, and passing up through the up-take flues, will be partially expanded in the flue around the top; at the same time be baffled and swirled, to a certain extent, before passing out into the down-comers. This will allow the heavier particles of the fine ore, that under existing conditions blow over with the gases, to settle on the inclined floors of the expansion and up-take flues; and being hot they will flow back into the furnace. There will not be heat enough in the top of the furnace to sinter together these particles as they settle, and as the great friction of the rushing gas will be against the up-take flue arches, the current will not affect this flowing back into the furnace of particles already settled on the floors of the flues. The movement of these particles will be like the action of hot sand on an incline. In the event of an explosion the expansion flue would allow a certain amount of compression, giving all the doors time to act in relieving the pressure.

Whether fine ores or the coarser ores are used in furnaces, the development of higher blast power at coke furnaces will have a tendency to bring about conditions at times resulting in severe explosions in the top of the furnace. It is with a view of providing a device by which, sooner or later, much damage may be saved the furnace, as well as loss of life, also that fine ores may be used with greater economy than at present, that the arrangement here described has been worked out.



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SMALL vs. LARGE MACHINE SHOPS.

BY W. D. FORBES, M. E.

A question which has often been asked the writer is whether a small machine shop can complete with a large establishment; so much depends upon what the question means that it can never be answered by an unqualified yes or no. If the question refers to the staple productions of commerce, as, for instance, a globe valve or pipe fitting, then no small shop can compete as the special tools required to machine either are expensive and they can produce but one article, and to make these fittings a brass and iron foundry must be a part of the plant, which at once places the investment beyond the reach of small capital. If, however, the question refers to jobbing, then a small shop can compete. It is a comfort to know that what are today large and perfectly equipped machine shops have all begun in a small way; or, if there are exceptions, the writer does not know of them.

Let us see how small a beginning can be made and with what prospect of success. But first we will not consider anything but the mechanical side of the subject, leaving the business side until later.

Of all machine tools there is no question but the lathe is easily the most important. With it not only regular lathe work can be done, but it will answer for drilling and in a small way for milling; and by the use of a properly rigged table or platen it can do good service as a boring mill. Now, as we are to equip a shop with the smallest possible outlay and yet be able to do a wide range of work, we must be careful in our choice of a lathe. It is strange that with the numberless lathes now in the market so few seem to possess all the desirable features of a good tool.

First, the lathe must not be a light affair, only able to nibble off stock; it must have weight and have it in the right place.

As to its size—14 to 16-inch swing is the most serviceable; the bed should be about 12 feet long. If possible it is better to get a five-step cone, if one can be found, which is well proportioned and well made, as it adds greatly to the range of speeds. Power is all important; and that a lathe has this must be carefully seen to by the purchaser.

Of course, the lathe should be back geared. A compound rest must be selected, as it adds greatly to the general range of work. Taper attachments are now so common and are so useful that they are strongly recommended, but they are not absolutely required. It adds at least $35 to the cost of a lathe; and if attached, the power cross feed is generally left off and such a feed is of great value. When only one of these two can be had the latter is the better to take. It is a very common fault to have the feeds far too fine, so the screw has to be resorted to in order to get good results; and as no lathe ever seen by the writer has had a screw of half its proper size, the wear at one part of it soon results in inaccurate work.

The carriage should be long on the shears, and, if possible, be provided with T slots, as a very convenient boring carriage can then be fitted to it. Of course, the carriage must be gibbed. As there are now most satisfactory friction cluches, these should be selected in preference to the tight and loose pulleys on the counter shaft, as in screw cutting the former is far quicker in action. There are many minor points about a lathe which are of importance and all men have their likes and dislikes, resulting from being used to a certain make. Good, large bearings and a hollow spindle are essential. About $400 must be set aside for the lathe.

After the lathe, which produces cylinders, we must provide a tool for surfaces which are flat or nearly so and we have a choice of three tools—the planer, shaper or miller. As to a miller, for the smallest possible equipment, it is not to be considered as against either the planer or the shaper. The first of these is too expensive and we must therefore fall back on a shaper. Its size should be about 16-inch stroke, and the writer considers some form of crank movement far more satisfactory than a friction moved ram, the main reason for this preference being that the crank shaper is positively to be depended upon for its length of stroke, which advantage is not possessed by the friction driven tool, at least so far as the experience of the writer goes. Of course, power is essential and is generally possessed by the shapers in the market. A good, large table should be selected, and it is very convenient if a shaft can be passed through the shaper under the ram in case a key way has to be cut in the middle of a long shaft. There are several good shapers, crank driven, which have the very desirable feature of an adjustment of stroke while in motion, and such should be selected. The purchaser should by all means refuse to buy a shaper which is belted on the left as the tool is faced. The machinist, when at work at a shaper, is seated on the right where the feed handles are under his right hand and it is very awkward to have to rise and reach over the ram to catch the belt in order to stop the machine quickly or to try a stroke, to say nothing of the danger. The price of this tool is about $250.

A drill press must be bought and the price of these very useful tools is now so low and the workmanship so good that the writer believes we are close to perfection. A 20-inch non-backed geared lever and worm feed drill can be bought for $70. It will drill up to one inch.

As a good machinist can forge his own tools, a forge must be bought and it would cost about $20. With it there must be an anvil, a sledge, a flatter, a hardy, one or two fullers, half a dozen tongues and a hand hammer. These would cost about $40. Provide a pail and a barrel, sawed in two, half of which can be used for water and the other half filled with sand for the anvil to rest upon. The shaper is provided with a chuck but the drill press and the lathe are not, so these must be bought. The cheapest chuck is the Independent, which is always four-jawed. These jaws can be of several styles, but what are called reversible are best for jobbing. The price of a 15-inch chuck is about $20. A drill chuck to take up to ½-foot will cost $6. The writer has always preferred a straight shank drill up to ⅜ diameter and a taper shank above that. A set of collets must be provided for the taper shank drills. A jobbing set of drills for ⅜ to 1-inch, advancing by 16ths will cost $10. A set of drills from No. 60 to No. 1 will cost $5. A set of lathe and planer tools, if forged by some good dresser, should cost about $20, which amount should give a good, serviceable lot. The shafting and counter shafts should be put up for $30; $15 will belt up the plant.

Of course it is supposed that power is to be hired, so a short line of shaft will have to be provided; 2-inch diameter is best and 20 feet or a single length is all that is needed besides two collars, both of which should be at one end—one on each side of the first hanger. Three hangers of 14-inch drop will be needed; a pulley to receive the driving belt and pulleys for the lathe, shaper and drill press; also a pulley for a small emery grinder. The grinder will cost, with wheels, $20.

The shafting and hangers will cost $15—the pulleys will vary with the make of tools, but $12 should cover their cost. Taps, from ⅛ to 1-inch, with two wrenches, will cost about $24. Reamers, from ¼ to 1-inch by $\frac{1}{16}$ths, will cost $18. Five gallons of lard and five gallons of machine oil will add $5 to the outlay, which includes a squirt can. Belt laces or hooks, with a set of tools, will cost $3.50. A set of hardened arbors, from ¼ to 1-inch, advancing by $\frac{1}{16}$ths, will cost $12. A set of dogs would cost about $5. A good swivel base vice will cost $5. We will allow for chalk, an assortment of set, cap and philister head screws, some semi-finished nuts, with some dull rods, a few bars of machinery steel, two or three of tool steel and a few files, $22—and we are ready to begin work after buying $10 worth of cards, bill heads and stationery.

About the first thing to do, after turning up the lathe centres, is to have some bolts forged with square heads and turn them up for use on the shaper and face plate work in the lathe—which would cost, say, $10. Some parallels must be shaped up with a pair of V blocks. Something must be provided to drive work on and off arbors, and very convenient blocks for this can be bought for $12. Some sheet brass and a lead hammer will be required. A set of disc gauges will cost $35 and will pay to buy.

The cost of power to run these tools will vary in different places, but $20 a month would be fair to pay for a small room with power. A young man who has been at the trade for two years and the owner could do all the work that the tools could take care of and with a lad to run errands and at times run the drill press, the shop would be complete.

Of course, no one would start a shop without some specialty to make or some work to do, and it will take some time before any profit can be made, as it is surprising how many things are wanted in starting a new shop, so that every cent that can be spared will have to go into buying what is wanted.

We will suppose that work can be obtained by the owner; still there will be times when there will be a few hours, or days, or perhaps even weeks when work is scarce and it is greatly to be desired that some article is taken up to manufacture which is in general demand and for which there is an outlet. The article must be of such a nature that its parts can be made in quantities and can be put in and taken out of the machines without requiring a costly resetting. Even if the margin of profit is small, so long as it is an actual profit it will add greatly in dull times to the success of the shop. Any such article is hard to find, but it can be found or designed.

If we go over the amounts noted, we will find the total $1,094.50, but it is safer to count it $1,200, which at 6 per cent. demands a return of $72 per year or, say, $1.40 a week. Shop rent and the insurance on the tools will amount to $5 per week. Help, as noted, would cost $13 per week and the owner will have to make his wages of $18 per week—making a weekly sum of $37.40. It is difficult to estimate the cost of material per week, as so much depends upon the nature of the work, but nothing less than $7 can be counted. This would foot up to $44.40 per week, of which $7 may be reckoned as neither profit nor loss, leaving $37 with which to meet actual expenses.

For the first month, no work is likely to be turned out which will bring in cash; in fact no returns should be counted upon for the first two months, and it is better to expect nothing in less than three, so if the shop is started free from debt and run three months, a capital of a little over $1,600 will be required.

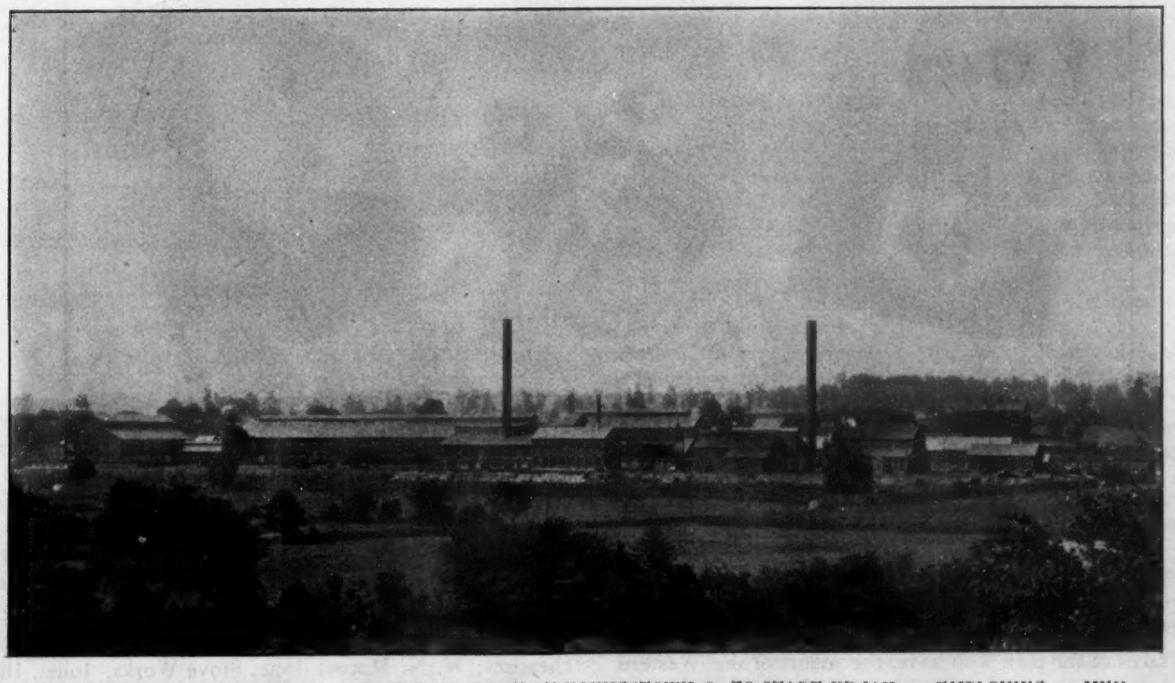
Now if work was brought to the door of the shop, paid for when done and taken away, there would be no question about the owner making a living, provided there was always work at the door, but the owner must go after work, make his collections and see customers who call, all of which takes time from his work. He should also keep some system of accounts. Without exception, the writer has found that bookkeeping is neglected by machinists from a mistaken idea, which they have, that it really makes no difference about keeping accounts; that all there needs to be done is to write a bill, copy it and get the money. If there is any one bit of advice of more value than another, it is that in starting a shop, one should first learn bookkeeping, or, if that cannot be done, to arrange with someone to come for an hour or so a day to keep the accounts straight. In this respect large establishments have a decided advantage over small ones.

Now, how much can a man and his assistant make in such a shop—if they have work? Forty-five cents per hour is the least asked for machine work, which would give a return of $9 per day or $54 per week—a gain of $17. Something should also be made on material—at least 10 per cent.—which would add to the possible profit. Also, many small jobs come in which are done at a much higher rate. This very small investment shows a large percentage of gain. But suppose there is even a very much larger gain, it will take years to save enough to be able to live on the income of the savings; and to arrive at such a state should be the desire of every man.

It is clear then that a shop equipped as above described, could only make a living for its owner, as loss by bad debts, bad work and many other losses are sure to be met with. What hope is there then for the small manufacturer? The hope is in enlargement, which must continue until a point is reached where, in taking an average working life, the profit will leave the owner, at the end of that time, a sum sufficient to live upon from its interest. A small shop must make a very large percentage on its work in order to give a living to its owner, and it can do so because its expenses are small, while a large shop can make a very much smaller percentage of profit, yet give its owner a living. The disadvantage of a large shop lies in the fact that the actual workers take very little interest in its success, while this is just the reverse in a small shop.

It is quite easy to see that if the plant here given was enlarged, say to the extent of a thousand dollars more, and two more men worked, the gain goes rapidly up as what may be called the "constant factor" does not advance much; in fact, only the interest account, while rent, etc., remain the same and the output of four men per day would be $18, while the advance in the "constant factor" would be about $1.20.

To recapitulate: our shop, with but three tools, is the most expensive possible, yet it permits a possible profit.

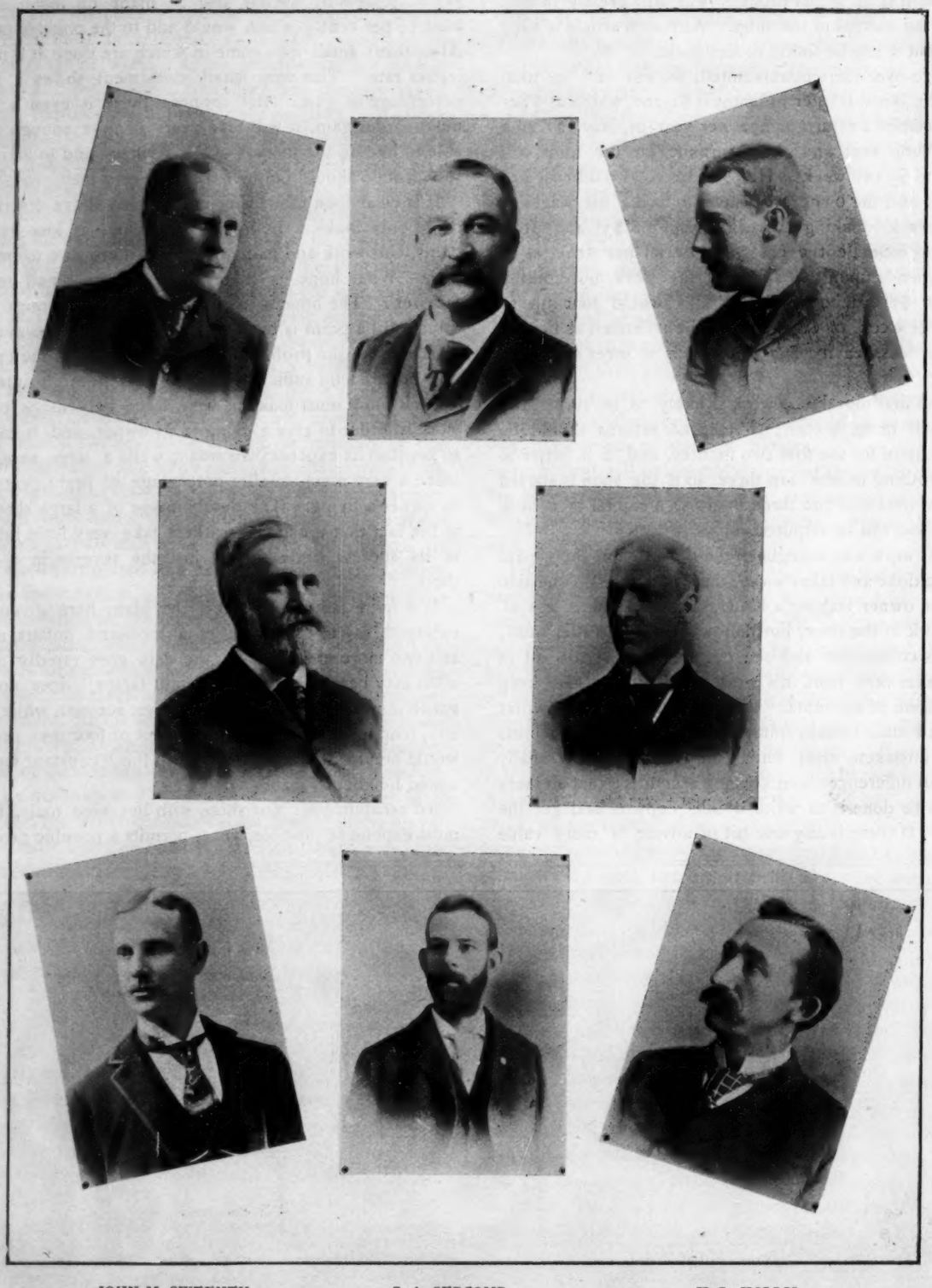


BIRD'S-EYE VIEW OF THE OHIO STEEL CO.'S PLANT AT YOUNGSTOWN, O., TO START UP JAN. 15, EMPLOYING 500 MEN.

THE WESTERN FOUNDRYMEN'S ASSOCIATION.

The foundrymen's associations, both East and West, have been the means of stirring up a vast amount of discussion of a profitable nature in the past few years, and there is no doubt that the results of their monthly meetings have been of great benefit, not only to their members, but to the large number of foundrymen who are not as yet associated. The officers of the associations are doing their best to increase the membership, and it is hoped that before long every foundryman in the country will be a member of one or the other.

It will be of interest to all Western foundrymen to see the faces of the men who have the affairs of the Western Foundrymen's Association in charge, and we take pleasure in presenting, in this issue, half-tone engravings from photographs of the officers of the association. The list is as follows: President, Geo. M. Sargent, president of the Sargent Co., Chicago, steel and iron railway castings; vice-president, C. A. Sercomb, of Schwab & Sercomb, Milwaukee, gray iron castings; treasurer, H. S. Vrooman, of the Garden City Sand Co., Chicago, foundry supplies; secretary, B. M. Gardner, of *The Iron Trade Review*, Chicago. Executive Committee—J. M. Sweeney, mechanical engineer, Chicago; O. T. Stantial, of the Illinois Malleable Iron Co., Chicago, malleable castings; E. C. Greenlee, of the Greenlee Foundry Co., Chicago, gray iron castings; H. L. Hollis, of Hollis & Emmerton, Chicago, analytical chemists; W. N. Moore, Joliet Stove Works, Joliet, Ill., stove castings.



JOHN M. SWEENEY. C. A. SERCOMB. H. L. HOLLIS.
GEO. M. SARGENT. B. M. GARDNER.
O. T. STANTIAL. H. S. VROOMAN. E. C. GREENLEE.

NORTHERN vs. SOUTHERN FOUNDRY IRON.

There has been not a little effort by the furnaces located in the Chicago district in the past year to gain as nearly entire control of the pig iron market in that territory as possible. This desire has had much to do with the remarkably low prices that have been made on Northern coke irons in that market in the past year. It was thought by the Chicago furnacemen that if the price of their iron was made considerably lower than that of Southern coke iron, there would be little difficulty in gaining the larger part of thebusiness. It has always been argued by Southern makers of pig metal, that consumers would have to use a certain percentage of their iron, as a corrective of the tendency of Northern coke irons to hardness. In answer to this argument, the Chicago furnacemen announced that they were prepared to furnish iron of any analysis desired; that they could make a mixture of their irons that would not need the addition of Southern softeners to make good castings, and that for at least some classes of work they could furnish an iron that would work well alone, and be a good scrap carrier.

With a view to finding out what effect the lowering of prices and other inducements offered by the Northern makers of coke iron have had upon the quantities of each kind used, *The Iron Trade Review* addressed a letter to a large number of the prominent foundrymen in the Chicago and tributary districts, asking them what percentage each of Northern and Southern coke irons they are using at present; what is the increase or decrease in the use of Southern iron by them in the past year, and their opinion as to the relative merits of the two classes of irons for their particular kind of work. To the 285 letters sent out, the number of replies received was surprisingly large, showing that the foundrymen of that territory are greatly interested in the subject. From the returns received we have collated the statistics that follow.

Of those who answered, 16⅔ per cent. are at present using Northern irons alone, and 7½ per cent. are using Southern irons alone. The balance are using both Northern and Southern irons in various proportions, ranging from 6¼ per cent. to 90 per cent. of Southern, and from 8.22 per cent. to 90 per cent. of Northern. In order to present the figures in their proper light, we have divided the replies into the following headings: Machinery founders, agricultural implements, stoves, and general.

An average taken of the amount of Northern iron used by the makers of machinery castings shows that 65 per cent. of the total is of this make, while 35 per cent. of the amount used is Southern iron. Of this class of founders, 20 per cent. report a decrease in the use of Southern iron, while only one founder reports an increase in its use. The average decrease for all the makers of machinery is 8½ per cent.

The average amount of Northern iron used by the makers of agricultural implements is 46½ per cent., the average of Southern iron being 53½ per cent. One founder reports an increase in the use of Southern iron of 5 per cent., and one a decrease in its useof 15 per cent.

The stove foundries show the most radical change of any class. The average of Northern iron used by them is 56 per cent., and of Southern iron 44 per cent. Sixty per cent. of those replying report a decrease in the use of Southern iron, and 15 per cent. report an increase in its use. The average decrease in the use of Southern iron is 22 per cent.

Makers of general castings report the use by them of 68½ per cent. Northern, as against 31½ per cent. Southern iron. Nineteen and a half per cent. report an increase in the use of Southern iron, and 33⅓ per cent. report a decrease in its use. The average decrease for all is 19¼ per cent.

For the total number of foundries replying, the average amount of Northern iron used is 59 per cent., and the average amount of Southern is 41 per cent. Nine per cent. of the total report an increase in the use of Southern iron, while 23 per cent. report a decrease in its use. The average decrease in the use of Southern iron by all the foundries reporting is 10 per cent.

It is possible that were complete returns received from every foundry in the Chicago territory, there might be some changes in these results, but the answers made represented an excellent average of both the larger and smaller foundries, and every part of the district was well represented among them. Altogether, these figures may be taken to represent as nearly as possible the entire territory.

While the results do not show that there has been any very radical change in the use of Southern as compared with Northern iron in the past year, they do show that the tendency is in the direction of a decrease in the former. The matter of price has entered very largely into the account. Whether, with a return to the old condition of from 50 cents to $1 difference in price in favor of Southern iron, the foundrymen will return to the use of the former proportions of Southern and Northern irons, is a question that can only be solved by actual practice.

The third question asked in our circular, "What is your opinion as to the relative merits of Northern and Southern coke irons?" can better be answered by quoting from the replies received. A majority of the founders, while answering the other questions, fought shy of this one; sometimes because of lack of experience in the use of one or the other iron, sometimes because they did not want to commit themselves, and in some cases for no given reason. The replies follow, those from makers of machinery castings coming first:

A light machinery manufacturer—I get the best results from a mixture of ⅔ Northern hard and ⅓ Southern soft iron.

Heavy machinery (marine) and general castings—Northern coke iron suits our class of work best, though we have no fault to find particularly with Southern coke iron. We use the iron that gives the best and strongest casting. At present using all Northern.

Heavy and light machinery castings—We have made a material change in the use of pig irons in the last year or two, as we have discontinued the use of Lake Superior charcoal iron entirely, and are using principally Northern cokes with a little Southern. We do not use as much Southern as we did by 25 per cent., owing to the fact that Northern iron can be delivered to us cheaper on account of freights, and also to the fact that we are buying our iron exclusively on a guaranteed analysis, which as yet the Southern manufacturers refuse to consider.

Medium machinery—Not much difference, but what there is is in favor of Northern iron.

General machinery—Northern iron is better and cleaner, but Southern iron is cheaper and has less shrinkage than Northern.

Heavy machinery—The Southern irons have less shrinkage than the Northern, but are not so strong. We think in our present mixture (33⅓ per cent. Northern, 66⅔ per cent. Southern) we have a neutral mixture.

General machinery—What Southern we have used ran much harder than the Northern irons we are using.

General machinery—Have been using Southern for the past year in proportions of ⅓ to ½, and as a softener (mixed with scrap) is all we desire.

Heavy machinery—Either makes excellent castings, but we mix, guided by price as to percentages.

Engines and heavy machinery—Now using all Northern, formerly used about 40 per cent. of Southern. We secure as good results in the use of all Northern iron as we ever did when using Southern.

General machinery—The one being cold short and the other red short mixed together ought to give a nice neutral iron.

Heavy machinery—The Northern coke irons answer all our requirements. Northern is convenient to get, while Southern is tedious and unreliable as to time. We have had excellent coke iron from both Northern and Southern furnaces.

Machinery and general—We use the Southern soft and Northern strong, and find the mixture satisfactory and lower in price than all Northern.

General machinery—The Southern iron is softer, cleaner and has less shrinkage than the Northern.

General machinery—The Southern irons are too dirty and not uniform.

General machinery—The Northern coke iron is a little harder (less silicon), a little more sluggish and dirty, but considerably stronger. The Southern is a little more fluid, not as strong, and not as susceptible of a high finish or polish.

High grade machinery—We get better results from using 25 per cent. Northern coke, 10 per cent. Southern coke, and 25 per cent. Lake Superior charcoal, with the balance No. 1 scrap.

The makers of agricultural implements express themselves as follows:

The Northern coke iron is the stronger of the two.

Northern coke iron has more strength, but Southern is softer, more fluid and less liable to shrinkage.

Prior to last year we used a mixture of Northern charcoal and Southern coke. Last season we found we could get a good strong casting for our work out of a mixture of all Southern coke iron.

We think it an advantage to mix Southern with Northern to correct the shrinkage of the latter; we use 40 per cent. Southern and 60 per cent. Northern. We think Northern coke irons are a considerable per cent. stronger than Southern.

It is advisable to use them together, about ⅔ Northern and ⅓ Southern. Even at the same price Northern is far the best if obliged to use either alone.

Both valuable in their place, but must be combined in such proportions as to produce an iron suitable for the individual use of the consumer.

Our experience is that an equal mixture yields the best results.

Both have merit and need to be used together to get the best results.

We use a strong Northern and No. 2 soft Southern in equal parts, which makes a very strong and fairly soft casting.

Stove foundries report as follows:

We use at present 90 per cent. Northern, 10 per cent. Southern, a decrease of 10 per cent. in Southern; this mixture we find as satisfactory as the old.

Northern and Southern in a ratio of 4 to 3 make a good mixture for stove castings. While we can make stoves of Northern iron alone, we have not yet tried Southern alone.

We have not used Northern coke iron for some time. Our last experience was that it caused the plate to be too hard, and the shrinkage is much greater than that of Southern iron.

Of equal merit when properly used. The cost per ton, with the preference slightly in favor of Northern irons, will be the determining factor.

At the same price we prefer Northern coke irons.

For our use the Southern irons are fully equal to the Northern.

We use 80 per cent. Northern and 20 per cent. Southern. At equal prices we would use 60 per cent. Southern, but with close competition must make a mixture that will cost us the least money and do the work.

The foundries classed under the head of "General" respond as follows:

Ornamental iron—We could not get the proper results without using both irons, Northern for strength, and Southern for softness and fluidity.

General—Northern iron is the best if we can get it soft enough.

General—We use Northern iron to tone down the Southern and add a little strength to the mixture. We are great admirers of Southern iron.

General—We use ⅓ each of Northern, Southern and scrap, and find our mixture is strong enough, and we are not subject to trouble from shrinkage.

Small and soft—We have always used Northern iron No. 1, with a little 5 per cent. silicon, and occasionally Ashland silvery.

Medium and light gray iron castings—Northern is the better by far.

General—We prefer the Northern iron, but can use Southern to a considerable extent.

Architectural—We regard the Northern iron as better in quality, but think the Southern is good for mixing.

Light and heavy gray iron—Until the past year we used Southern iron almost exclusively. Are now using 90 per cent. Northern coke, 10 per cent. Lake Superior charcoal, which mixture gives us the best results.

General—We prefer Southern, for it mixes better with scrap. The tendency of Northern iron being to hardness, forces us to use a smaller percentage.

Railroad castings—Southern iron has given the best satisfaction.

Railroad castings—We prefer Northern.

General—We like to have both in our mixture, but should probably use all Northern iron if it were not for the difference in price (usually) in favor of Southern iron.

THE AMERICAN TIN PLATE INDUSTRY.

BY "CINDERS."

There is probably no industry established in this country which has suffered more at the hands of incompetent writers and talkers than the manufacture of tin and terne plates. The political majority of our national legislative body, which recently has been relegated to the rear, have not yet conceded the fact that a sheet of iron or steel coated with tin is a genuine article known commercially as tin plate. They are not willing to acknowledge that the industry has passed its incipient stage, yet they have used every means to check its growth. In the face of all these efforts, however, the industry has thrived and its present condition is a source of much satisfaction to its friends. Tin mills, or what are more correctly called black plate mills, have increased in number to an extent that it is almost alarming to those interested in the industry. The dipping capacity has kept pace with the supply of domestic black plates and to-day it is opportune to ask whether or not over-production will soon make itself apparent.

Official Reports.

Bewildering figures are not necessary to show the remarkable growth of the business during the few years elapsed since the McKinley law became effective. The general totals are sufficient to demonstrate conclusively that the manufacture of tin and terne plate will henceforth continue and become one of the most important industries of this country. A careful study of official reports will show the following results:

Total quantities of plates coated weighing 63 lbs. and less per 100 square feet:

1891–92	6,823	net tons
1892–93	49,909	" "
1893–94	69,612	" "

Total quantities of plates of American manufacture coated, weighing not more than 63 lbs. per 100 square feet, compared

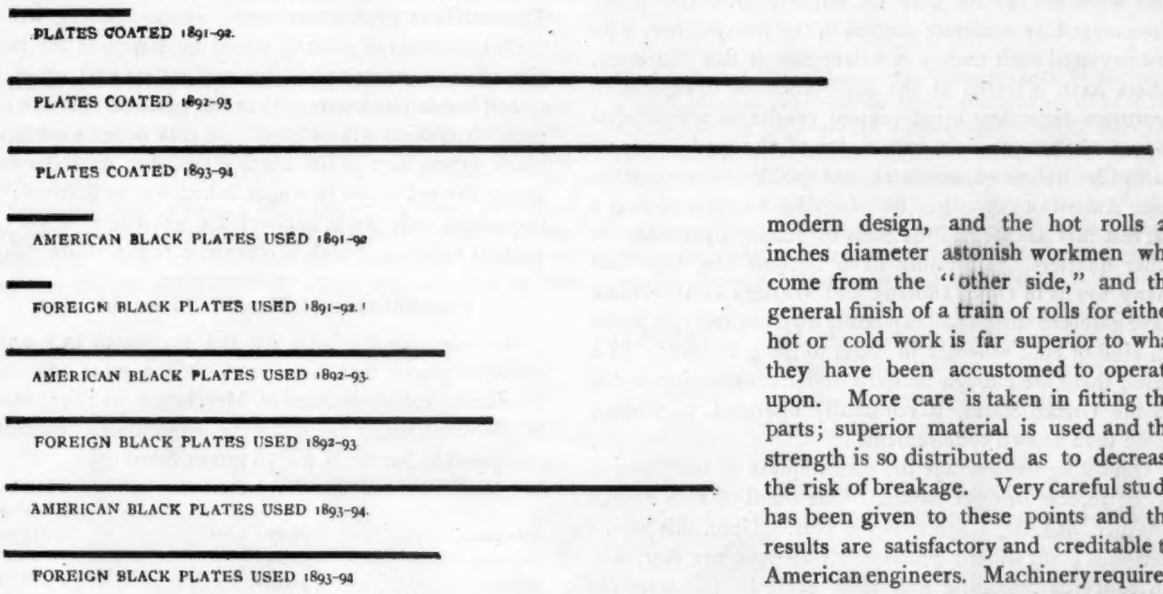
with total quantities of foreign manufacture of similar gauges, imported into the United States:

1891–92	4,648	net tons
1891–92	2,175	" "
1892–93	21,799	" "
1892–93	28,110	" "
1893–94	42,985	" "
1893–94	26,627	" "

Figures underlined represent plates of foreign manufacture.

These are results produced in a new industry within three years under conditions of the most unfavorable character, during a time of unprecedented business depression and in face of opposition, pronounced in character, from men whose views have long been held in high esteem by friends and opponents alike. Yet the industry has thrived and has now arrived at a stage where progress cannot be retarded, except at the expense of the wage earner.

Comparisons made in graphic form present a much more striking illustration as follows:


PLATES COATED 1891-92.
PLATES COATED 1892-93
PLATES COATED 1893-94
AMERICAN BLACK PLATES USED 1891-92
FOREIGN BLACK PLATES USED 1891-92.
AMERICAN BLACK PLATES USED 1892-93.
FOREIGN BLACK PLATES USED 1892-93
AMERICAN BLACK PLATES USED 1893-94.
FOREIGN BLACK PLATES USED 1893-94

Attitude of Foreign Workmen.

At the outset, those venturesome ones who became financially interested in the business were beset by well meaning, but illiterate foreigners who spoke in whispers and would not answer questions. They professed ability to do the work, but would not tell how to do it. Little by little they learned that while age and experience are respected as much in this country as in any other, a little good "horse sense" is a necessary adjunct to produce desired effects. Their stubbornness made Americans the more determined to learn their supposed secrets, and, as a result, there are a great many Americans to-day who are as well informed in regard to the business of manufacturing tin and terne plate as the average Welshman or Englishman. The antipathy of foreign workmen towards those of American training is well known, but has failed in its effect, which was to prevent any but their own nationality from learning the operations of a tin mill. They have molested Americans and destroyed machinery in order to prevent operations where Americans were employed. They have placed every possible obstacle in the way to prevent others from learning the trade and have lived to see a day when it would be an easy matter to raise a subscription large enough to pay the expenses of the discontented ones back to the old country, whenever they are ready and willing to go.

Success of American Workmen.

It is a well known fact among mill men that young American rollers and others have quite recently produced better work and larger quantities in a given time than foreigners working their eight hours shift with the same furnaces and machinery, and it is useless for any prospective manufacturers to imagine that a crew of foreigners is a necessity in a tin mill.

Improved Machinery.

Parallel with the progress made in training native workmen to the performance of tin mill duties, American engineers and mill managers have placed a record which would surprise foreign manufacturers if they knew its exact character. American mills have been built, which are so constructed that the product is increased at least one-third during 24 hours. The points where strength is required in machinery have been eagerly sought for and necessary changes made. The six-ton housings of British make appear like toys alongside eleven-ton housings of modern design, and the hot rolls 24 inches diameter astonish workmen who come from the "other side," and the general finish of a train of rolls for either hot or cold work is far superior to what they have been accustomed to operate upon. More care is taken in fitting the parts; superior material is used and the strength is so distributed as to decrease the risk of breakage. Very careful study has been given to these points and the results are satisfactory and creditable to American engineers. Machinery required for the manufacture of black plates differs very little from sheet mill machinery. The housings are identical in design, but rolls are much shorter in the body, the regular length being 32 inches. Bars are worked at a much lower degree of heat on black plate mills, and consequently roll trains must be kept in first class condition in order to withstand the extraordinary strain. In work of this kind, American millwrights are far ahead of their trans-Atlantic cousins (in the "Black Country" especially), probably because the machinery in their care is of superior construction.

Changes in the design of machinery have not been made to the extent that might be supposed, judging from the greatly increased product. No radical changes have been made, but there are many of minor character. More symmetry of design is noticed in trimming shears. The old alligator style is not used. Modern squaring shears take their place, and a saving in cost of labor performed is effected. The doubling shears, always an unsightly object, also built on the alligator plan, have not been changed much, but as this article goes to press, a Cincinnati firm is engaged perfecting a doubling shear of vertical, instead of horizontal, design, which appears to be a decided improvement over the old style.

In pickling machines foreign designs have been greatly improved upon; at the same time only two standard machines are offered on the market, each of them being

very decided improvements upon their English prototypes, constructed with a view to save both material and labor.

In tinning machines, remarkable improvements have been made. One style of machine, now very popular with the trade, was at no very recent date sold for $2,000. To-day it can be bought for less than $400, with all improvements added. So it is no longer necessary to pay Britishers a premium to teach us how to build dipping machines.

This illustrates briefly the steps taken towards advancement in the art of tinning, and it is this advantage alone that enables Americans to hold their own against foreign competition under recent tariff legislation. Interested artisans have never offered the slightest assistance in the shape of acceptance of reduced wages, although highly paid.

A Complex Situation.

In the flush of success we meet danger. The inventive genius of Americans has made it possible for them to combat successfully with old world manufacturers during a time when the rate of duty on imports protected them. Encouraged by moderate success of the intrepid few, who first invested their money in enterprises of this character, others have invested at the solicitation of irresponsible venturers dependent upon present results for a livelihood —men whose superficial knowledge of the trade, accompanied by unlimited assurance, has enabled them to influence American capitalists for the time being and reap a harvest that has formed the basis of similar operations in other quarters. Tin mills have become the rage and many towns in Ohio, Indiana and Western Pennsylvania have gathered their small capitalists together and concocted all kind of land schemes in order to get a tin mill. As a result there are enough tin mills under construction to-day in the United States, if constantly operated, to produce more than known requirements.

Official figures average the consumption of tin plates at about 20,000 tons per month. One stand of rolls should produce, at least, 1,750 tons per year. Upon this basis a four-mill plant should produce 7,000 tons per year, and 30 concerns operating four mills each, or 120 stands of hot rolls, can keep even with the domestic demand, without counting on what might be imported by those who must have certain grades of Welsh tin, because they never used any other kind and will not believe that their own countrymen can produce material equal in quality. There are now 136 stands of black plate rolls either in operation, under construction or idle in the United States. If operated to their full capacity, they could produce 7½ tons each during 24 hours, and at 300 working days per year, after allowing for delays, holidays or exigencies, the annual production would be 225,000 net tons, more than enough to supply the domestic demand.

Coupled with this unfortunate craze for building tin mills, labor troubles are met which are complicated in their character, and may have a very important bearing on the ultimate disruption of the Amalgamated Association of Iron and Steel Workers, an association which exists in name chiefly, and is supported by dues collected from men who are not acting consistently with their avowed allegiance to it, but who are exonerated on account of the proportions of their bi-monthly remittances. These statements are facts, and not fancies, and can be fully proven. The members of the Amalgamated Association of Iron and Steel Workers were, with a few exceptions, totally ignorant of the work required on black plate mills, yet they have acted as the champions of strangers who came to this country in search of employment as skilled operatives, and have led them to believe that to work non-union is a sin. They have collected dues from the unsophisticated foreigners and filled them to the brim with the idea that they cannot succeed if they do not let the executive committee of the association run their affairs. But the bare necessity of the situation will soon assert itself. Within the past three months black plates have been reduced in price to the extent of $18 a ton. Bright plates have been reduced in similar ratio, all through foreign competition. American mills have been idle since the passage of the new tariff bill, and imports have increased. If the figures are withheld as long as those of the special agent of the treasury, who reports on the development of the tin plate industry, their effect will be partially lost, but it is already apparent that nothing except a reduction in the wages of tonnage men employed on tin mills can save the industry from the ignominy and disgrace of being wiped out of existence for the benefit of importers and foreign manufacturers.

A tin mill roller can easily earn $10 per day at eight hours at the scale of wages proposed by the manufacturers. Thousands of professional men, whose learning has cost them thousands of dollars, would be happy in the possession of such an income. Tin mill rollers and other high priced hands must soon realize the position they are in, or their occupation will be gone. It may prove expensive to teach green men to roll black plates, but it is inevitable unless the reduction in wages asked for is granted; and opposition only tends to check the growth of a very important industry, which is otherwise firmly established.

Possibilities of Mesabi Mines in 1895.

As indicating the basis for the statement in his article on other pages, that there would be no great difficulty in producing 4,000,000 tons of Mesabi ore in 1895, Mr. H. V. Winchell sends the following approximate estimate of the possible output of the 20 mines listed:

Mine.	Possible output in 1895.	Method of mining.
Adams	150,000 tons	Stripping.
Auburn	250,000 "	"
Berringer	150,000 "	"
Biwabik	500,000 "	"
Canton	350,000 "	Underground.
Cincinnati	20,000 "	"
Commodore	50,000 "	"
Fayal	50,000 "	Stripping.
Franklin	300,000 "	Underground.
Hale	30,000 "	Stripping.
Lake Superior	100,000 "	Underground.
Lone Jack	50,000 "	Stripping.
Mahoning	250,000 "	"
McInnis	50,000 "	"
Minnewas	100,000 "	Underground.
Mountain Iron	1,000,000 "	Stripping.
Norman	150,000 "	"
Ohio	50,000 "	"
Oliver, (Mesabi Mtn.)	800,000 "	"
Sellers	50,000 "	Underground.
Total	4,450,000	

Mr. Winchell adds: "In addition to these there are mines like the Rouchleau in 58-16, Rouchleau in 58-17, McKinley, Shannon, Shaw, Great Northern, Great Western, Moose, St. Clair, Lowmoor, Iron Chief, Longyear in 58-20, and in 57-21, the Mesabi Chief and others, any one or all of which could be made productive if preparation was begun this winter."

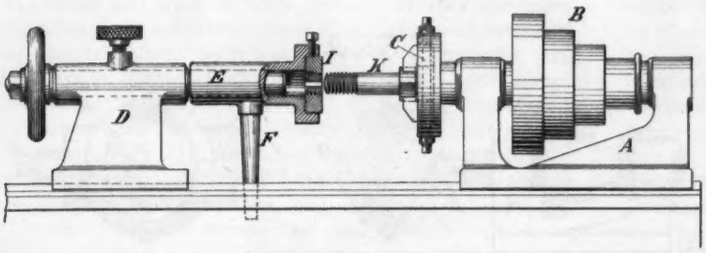
THE Sargent Co., of Chicago, have recently made two cast steel gear rims, weighing 1,200 pounds each, for the Washburn & Moen Mfg. Co., for use at their Waukegan, Ill., plant. They are said to be very accurate in pitch and diameter.

MACHINE-SHOP ECONOMIES.

Mr. James Brady presents in the *Engineering Magazine* a number of valuable suggestions as to mechanical economies, which, he says, have helped out greatly in the execution of a variety of work. We take pleasure in reproducing portions of the article, together with illustrative explanations:

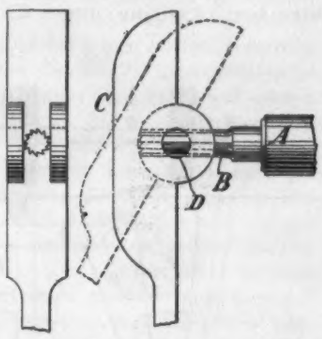
A quick and very effective way of flattening punched blanks of brass or other ductile metal is to bunch them in lots of a dozen or more lying one upon another, and strike the bunch with a drop-hammer. Blanks may be very quickly and perfectly flattened in this way, that could only with great difficulty, if at all, be brought to the same perfection by treating them singly.

FIG. 1.



To do bolt cutting on any lathe, the arrangement shown in Figure 1 may be employed. *A* is the head stock; *B*, cone pulleys; *C*, chuck; *D*, tail stock; *E*, a sleeve fitted to slide on and over the tail stock spindle; *F*, an arm attached to the sleeve *E*; *I*, screw cutting die. The blanks *K* for the bolts, having been cut to desired lengths and pointed, are chucked, and being entered at the pointed end into the die the cutting is readily performed, the sleeve *E* being prevented from turning by the arm *F*, but sliding freely on the tail spindle *E*. A method of milling out the inner surfaces of what are known as rule-joints is shown in Figure 2. *A* represents the live spindle of a Brown & Sharpe milling machine. *B* is a cylindrical milling cutter, mounted in the spindle; *C* is the work mounted on the revolving head of the machine, and so adjusted that it makes a partial revolution around the center *D*. These joints, which are of frequent occurrence in certain kinds of machine construction, can be rapidly, accurately and cheaply fitted by this method.

FIG. 2.



There came into my establishment at one time an order to make ten knitting-machine cylinders. These were hollow, and through their sides there were to be drilled a number of holes disposed in a certain way. A sample cylinder was sent with the order, and the order was explicit that the holes (all of one size) must be bored and located in positions exactly the same as the sample. The expense of a jig for this work put this resource out of the question at once. Another method was resorted to which located the holes perfectly.

This is illustrated in the sketch, Figure 3, in which *A* represents the spindle of a Brown & Sharpe milling machine; *B*, a drill chuck; *C*, a test plug of the exact size of the holes to be drilled; *D*, the worm head of the machine; *E*, the cylinder to be drilled—shown in section and having holes at the bottom for dowel pins, *G*; *F*, a cast-iron piece made to fit the interior of the cylinders and fastened to the worm head so as to properly center the cylinders; *I*, a clamping bar which firmly held the cylinders when the screw bolt *H* fitted into *F* was tightened down. The adjustment of the pattern cylinder having been exactly made for any one of the holes so that the test plug would exactly enter it, the head was allowed to remain in the same position, the pattern cylinder and the test plug removed, the cylinder replaced by a cylinder to be bored, and the test plug by the drill, and the holes were thus exactly drilled in their required places. The dowel pins at the bottom which were all drilled in the same position relatively to one of the holes, insured the correctness of position of any hole in the horizontal plane. Of course, some time was consumed in handling, but the cost of this was only a small fraction of the cost of a jig.

FIG. 3.

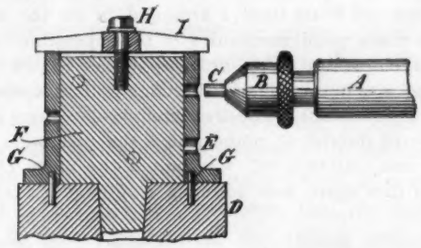


FIG. 4.

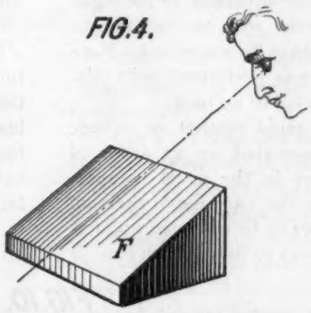
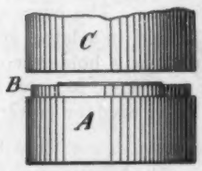


FIG. 5.



A handy time-saving device is shown in sketch Figure 4. This is a combined anvil and face-plate having an inclined face *F*. This face is made true, and may be called an inclined face-plate. It is used as an anvil in straightening pieces with a hammer and in testing pieces for straightness, and where a considerable number have to be handled it saves a great deal of time. For example, suppose a workman to be holding in one hand a piece which he has been working upon by a tool held in the other hand; he can, without laying down the tool (file or hammer), apply the piece to the face-plate to discover

FIG. 6.

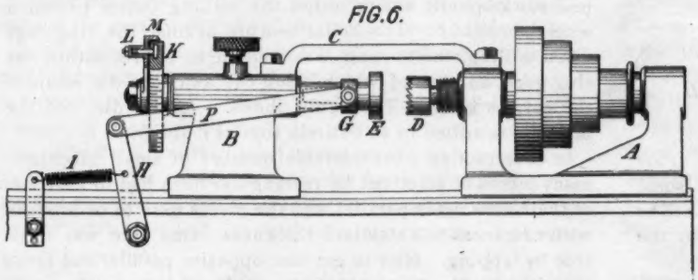
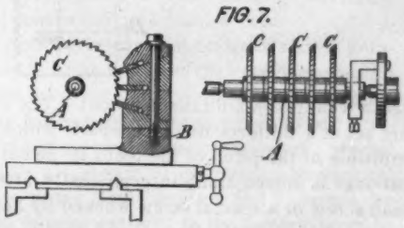


FIG. 7.

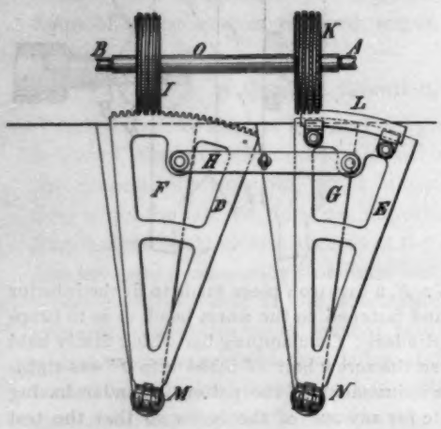


defects, instead of laying down the tool, taking up a straight edge and adjusting the piece to the straight edge. In work of this kind minutes rapidly multiply into hours, and if seconds can be substituted for minutes, it is worth every man's while to do this.

The diagram, Figure 5, illustrates a method of compressing to gage brass blanks, by hydraulic force. *A* is the anvil; *B*, a ring gage; *C*, a follower. The blanks are successively placed in the gage and pressure applied. It is a much cheaper process than turning them off, and it compacts the metal so that the gears are stronger and wear better in use.

Figure 6 illustrates a method of face-milling to gage, in a lathe. *A* is the headstock; *B*, the tailstock; *C*, a stiffening brace bar; *D*, milling cutter; *E*, piece operated upon; *P*, a

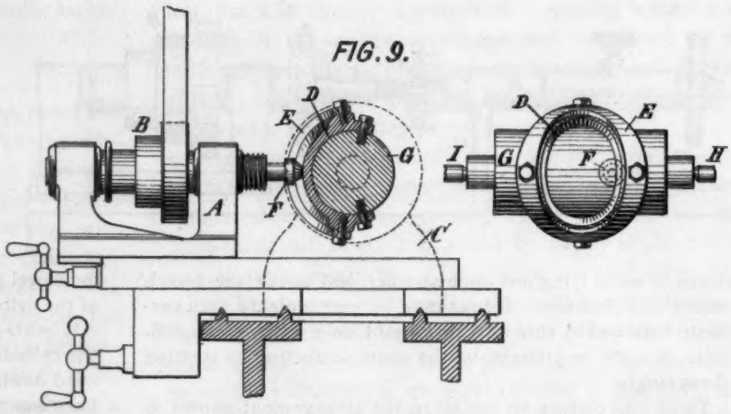
FIG. 8.



link pivoted to the collar *G*, and at the other end to a rock bar *H*; *I*, spring; *K*, graduated hand wheel on tailstock spindle; *L*, an adjustable stop attached to *K*, having an index finger and so set that when the spindle has advanced to the right point to gage the cutting, the end of the rock bar is brought under it, and the motion of the spindle is thus arrested. Face milling to a uniform gage can be thus performed with dispatch in a common lathe to within $\frac{1}{10000}$ of an inch.

Figure 7 illustrates a method of rapid ratchet or square tooth cutting. The cutters *C* are mounted on an arbor *A* which is held in a lathe and revolves in the usual manner. *B* is a clamping holder mounted on the carriage of the tool post and arranged to hold three pieces to be operated upon at once. I have used ten cutters in this way so that at each feed 30

FIG. 9.

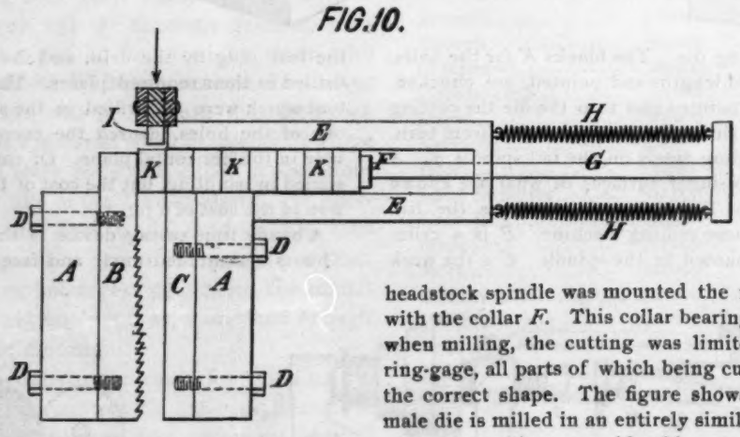


teeth would be simultaneously cut. The cutters on the arbor are set at a uniform distance apart, which distance is some multiple of the pitch of the teeth to be cut in the rack. The carriage is moved along intermittently after each cut by the lead screw or a special screw worked by hand.

A method recently devised and employed by me in cutting a large number of thin segmental racks, the pitch line of which was required to be on a radius of 36″ is shown in Figure 8. *A* is the dead center and *B* the live center of a common lathe. On the shears of the lathe are rigidly clamped two strong triangular iron frames, *F* and *G*, projecting horizontally forward. To *F* is attached a movable frame *D* by a universal joint at *M*. A similar frame *E* is connected at *N* to *G* in a similar manner. The frames *D* and *E* are connected by a link *H*, so that one moves precisely like the other, in a horizontal plane, on ways at the front ends of the frames *D* and *E*. On the front end of *E* is a clamp which holds the blank sector *L* to be cut. On the front end of *D* is a toothed sector in which meshes the worm wheel *I*. *K* is the milling cutter, the teeth of which are arranged in manner analogous to the teeth of a die for tapping nuts. Both *I* and *K* have a very small pitch, and their diameters are large in proportion to their pitch. They are mounted on an arbor *O*, which is supported by the lathe centers and driven in the usual way. *I* acts through the toothed sector and link *H* to feed the blank *L* to the cutter. I should hesitate to say here how rapidly and cheaply I can cut a thousand of these racks with this device; the figure is so low that it would hardly be credited unless the operation is itself first witnessed. As each rack is completed a new one is substituted, and by means of a rope running over a pulley and attached to an eye in the middle of the link, the front part of both *D* and *E* are lifted and swung back to their initial position.

In milling male and female dies for rolls intended for use in rolling out tin and brass trays, I arranged to do the work—thought by many good mechanics to be impossible—as follows: On the carriage of an ordinary lathe, Figure 9, the headstock *A* was mounted, and the cone pully operated by a belt from a countershaft. The live and dead centers of the lathe supported the roll *G*, upon which the dies were to be mounted in use. To this roll was bolted the piece *D*, to be milled. To this again was bolted a ring-gage *E*. On the

FIG. 10.



headstock spindle was mounted the milling cutter provided with the collar *F*. This collar bearing against the ring-gage when milling, the cutting was limited to points within the ring-gage, all parts of which being cut away the die attained the correct shape. The figure shows a female die, but the male die is milled in an entirely similar manner.

In constructing a considerable number of small machines, many pieces of steel cut in rectangular form had to have two of their sides made parallel, and the pieces were to be brought with exactness to a standard thickness. One side was made true by lapping. How to get the opposite parallel and bring the pieces to the required width rapidly and cheaply was answered by the device shown in Figure 10. Any shaper will do for this work. To the bed is fitted a metal piece *A* planed out midwise to receive the hard steel guide *C* and the fixed cutter *B*, leaving a flat-bottomed space between *B* and *C*. Extending laterally is a channel F in which the pieces *K* to be shaved off are placed. *F* is a follower, having the stem *G*, and actuated by the springs *H*. *I* represents a pusher fastened in the tool-holder of the shaper, and which is made to traverse

through the space between *B* and *C*, pushing before it one of a series of the pieces *K* which are placed in the channel *E* with their lapped sides toward the follower. In passing through the space between *B* and *C*, the pieces *K* are shaved down to exact widths, and one can be finished and thrown out at each traverse of the pusher *I*. The edges of the cutter teeth are inclined slightly from the perpendicular, so that the tendency of the piece operated upon is downward toward the bottom of the space. For about one-third the distance from the exit end, the line of edges of the teeth is parallel to the guide *C*, and by means of the adjusting screw *D* the width of the finished pieces can be gaged with great nicety.

I have thus presented a few of the resources for economies in special work that, from time to time in the progress of a varied business during many years, have enabled me to force a profit out of what at first seemed rather unpromising jobs; and I have done this with a view to help others. I do not believe much in "shop or trade secrets," as they are called. The attempt to hide from others what has proved successful, has often stimulated the invention of a more successful thing than the one concealed, ultimately making competition more unequal than the secret method did, and giving advantage to the side on which it was least desired by the concealer. I believe that when useful methods are known their promulgator confers a public benefit, for which other and higher than pecuniary rewards will follow, and in this spirit I am always willing to respond to anyone who makes inquiries, knowing that in the end I shall receive more than I can possibly impart.

IMPROVEMENT IN FOUNDRY METHODS.

Views of Practical Men on Recent Developments.

The Iron Trade Review addressed this question recently to a number of practical foundrymen:

In what direction has the greatest progress been made in foundry methods and appliances in the past few years, and on what lines may the most rapid advance be expected in the near future?

The answers received coincide on several of the more obvious features of foundry advance in the period referred to. It is certain that the fall in prices of iron products of all descriptions, including everything produced in the foundry, has brought a closer study of economies and therefore a more general introduction of labor-saving appliances. It is admitted, however, that the foundry has moved far less rapidly than the rolling mill, the steel works or the machine shop. Yet a greater independence of traditions is a characteristic of the founder of to-day, and when once it is understood that the foundry is not exempt from the evolution that is going on in every department of the iron world, the march toward ultimate economies will be at an accelerated pace.

Wm. D. Sargent, general manager of the Sargent Co., iron and steel founders, Chicago, writes:

I think the answers to both parts of this question can be made at the same time. As I look at it, we are in the midst of a general improvement of methods and appliances. We are learning to buy our pig iron by analysis; to get a ratio better than one to ten fuel to iron in melting and to get greater strength in the casting from lower grades of iron in the mixture. The fluid iron is carried to the molds on tramways, or the molds to the cupola on cars; our flasks are of metal, not cast, but rolled steel and adjustable; molding is more largely done by machinery and dry sand cores are replaced by green sand or iron cores.

From A. Sorge, Jr., superintendent of Fraser & Chalmers, Chicago:

The first part of this question can, in my opinion, be answered by stating that internal transportation facilities in the way of cranes, travelers and other means for mechanically moving and transporting material from one part of the foundry to the other have undoubtedly contributed more largely to the advance in foundry work up to date than any other agency. The future advance may, in my opinion, be expected in the direction of more thorough experimental work, both chemically and physically, together with exact records and observations of all conditions under which the work is done. In other words, the more complete application of modern technical knowledge and scientific methods will enable the future foundryman to produce and reproduce his results with more certainty than heretofore. It appears to me that we are now in a transition state, in which the old battle between so-called theoretical and practical men which has been so thoroughly fought out in other pursuits is again being gone through with reference to foundry work; and here, as well as in other branches, it seems to me the final victory will undoubtedly lie with the party whose methods are based upon scientific observations. I do not wish to be misunderstood as saying that the application of theoretical chemistry will solve all questions, because the skillful manipulation of cupola, sand and all materials used in the foundry will always be a large factor in successful work. But the man possessing this necessary skill in manipulating and applying a thorough technical knowledge of chemistry and strength of materials will produce results with a certainty which the mere empiric cannot hope to attain. I would, therefore, thus sum up my opinion of the direction in which the most rapid advance in foundry methods and appliances may be expected in the near future: the application of scientific methods and chemical knowledge, together with accurate records of the precise conditions in such shape as to be readily available and comparable with the observations of others.

Alex Backus, president of the Vulcan Iron Works Co., Toledo, O., makes this comment on foundry needs:

It would be quite difficult for us to tell where any great improvement has been made in the foundry appliances in the last few years, or where the most rapid advance may be expected. We would say, however, that there is a great opportunity for some means of more rapid melting, and also of converting the iron into different qualities in the ladle.

John M. Sweeney, mechanical engineer, Chicago, whose experience has been largely in heavy founding, says:

The question at once separates itself into the consideration of two cycles:

1. "In what direction have foundry methods and appliances been most improved in the past few years?"

I think generally in the direction of more concise and determined methods, which have, however slight, assisted in securing a more regular operation. The application of the pyrometer to the core oven was productive of lasting benefit, a something whose value could be easily pointed out, that found favor at once, and did not require to be seen in operation to be understood. In this it was different from many improvements. Foundry work, the making of molds, is peculiar. It requires brains properly applied, ability to reason from cause to effect, which in turn requires experience. So is it, that we look to older men rather than the young men for instruction. Mr. James Hemphill, of Pittsburgh, recently said to me on the subject of molding: "After all, it is the 5 per cent. of experience which does the work."

The literature on molding progresses slowly because this experience is difficult of transmission. One person cannot convey to another just how hard to ram a mold, or just in what order the vents came off a successful casting; therefore the evolution is slow, contracted, in a narrow field.

Perhaps the most noticeable contrast between recent foundries and those of twenty years ago is in the crane service. In those making a varied product, but comprising castings of larger weight, nothing has had so much influence as the "overhead traveler" of rapid movement. In special work, special appliances and methods are always to be found. Mechanical molding machines are doing great service; but I assume the questions propounded to refer entirely to the generic term.

2. "And where may the most rapid advance be expected in the near future?"

This question provides ample scope for the most vivid imagination. During recent centuries the mechanical field has produced much, while chemistry more recently has become, in some metallurgical processes, the guiding hand. What the foundry lacks is chemical care, and it is here that we must look for the future advance. What chemistry is to the blast

furnace, and to the steel-maker, it may be to the founder. Not in a day, not all at once, but adopted, tried, intelligently pursued—not abandoned at the first trial because of some conflict—but used with a determination to discover its value, its field will soon broaden. It will assist in mixtures of sands as well as of irons, in facings and blackings as well as in cokes and fluxes, and in the value of the final product for its intended purpose.

P. D. Wanner, chairman of the Reading Foundry Co., Ltd., and vice-president of the Foundrymen's Association:

I do not know of any special improvements in foundry methods and appliances, except in greater dispatch in turning out work, and in the handling of the iron, in pouring and in the movement of castings afterward. Whatever was wanted of late years, in almost every direction, was wanted quickly, and the foundry business was no exception to that demand. Otherwise, I know of no improvements except a better knowledge of the different brands of iron to be used for particular castings, by themselves or in mixtures, in order to obtain a desired result; and improvement in cupolas or processes of melting. I can see no advancement for the future in this trade. On the contrary, it is likely to be still more curtailed in its output, as it has been of late years very materially by the introduction of wrought iron, steel and malleable castings. The future for general foundrymen does not strike me favorably.

W. N. Moore, president of the Joliet Stove Works, Joliet, Ill.:

Outside of special productions for which molding machines and special mold appliances have been introduced, the advancement of the founders' art has not been rapid nor pronounced in any one direction. The changes in foundry practice have been notable in the direction of a better understanding and more accurate application of old processes, rather than in the introduction of new methods. There has been some improvement in cupolas, cranes and other appliances, and in some quarters a considerable start made toward a definite understanding of the value, for every day use, of the various elements present in cast iron. Much has been learned and very much more is to be learned from the chemist and the testing machine. It is probable that the greatest advance in the immediate future will be in this direction. There is, however, a wide field for advancement in the process of melting iron. Electricity is a possible solution, but there is room for vast improvement in the cupola.

Thos. D. West, manager of the Thos. D. West Foundry Co., Sharpsville, Pa.:

In reply to the first question, I would say:

1. In building stronger and more commodious shops.
2. In providing better ventilation and light.
3. In having power replace hand cranes.
4. Greater economy in cupola work by better knowledge of the science of melting.
5. In having the elevator replace the wheelbarrow to raise stock to the cupola.
6. In a more intelligent selection of iron for mixtures.
7. In having better facilities for the importation and exportation of supplies and products.
8. In adopting improved methods and appliances for turning out smooth castings, which in light work largely implies the use of improved follow-boards, flasks, tumbling barrels and emery wheels. In heavy work the use of silver lead and the pickling vat.
9. In a study of the principles involved in the art of molding, most advanced by reason of foundry literature.
10. In competition cutting down profits, until to-day the founder who can make ends meet considers himself away up in G.

To answer the second question, I would say:

1. To a more general adoption of chemistry in founding.
2. To a more intelligent understanding of the physical properties of cast iron.
3. To more positive assurance of attaining desired qualities in castings.
4. To have purchasers learn and concede that a soft casting must possess less strength than a hard one, barring white iron.
5. To have more attention paid to the quality of strength in castings.
6. To simplify and make late improvements in machinery appliances more practical and economical in the item of repairs.
7. To greatly enhance improvements in cupola construction.
8. To a greater adoption of electrical and mechanical appliances to economize in the production of castings.
9. To develop and exact higher ability in shop management and encourage the adoption of some universal apprenticeship system.
10. To have foundrymen encourage and support an organization to advance knowledge and retard ruinous competition in founding.

From O. T. Stantial, of the Illinois Malleable Iron Co., Chicago:

From my standpoint, I will say that the two greatest improvements of the past few years have been:

1. The introduction of machines, to take the place of manual labor in the production of castings, thereby increasing the output and decreasing the cost.
2. The more intelligent mixing of irons, due to the application of chemistry and metallurgy, thereby enabling the foundryman to use cheaper irons to replace high-priced irons, and at the same time obtaining a more regular, uniform and better quality of casting. The latter, while being true to a large extent in the mixtures of grey iron, is even more noticeable in the mixtures of malleable iron, where, by the aid of the chemist, the use of high-priced charcoal iron has been in many cases almost, and in some cases entirely, superseded by the use of lower priced coke irons, thereby making a great saving, not only to the foundryman, but also to the consumer.

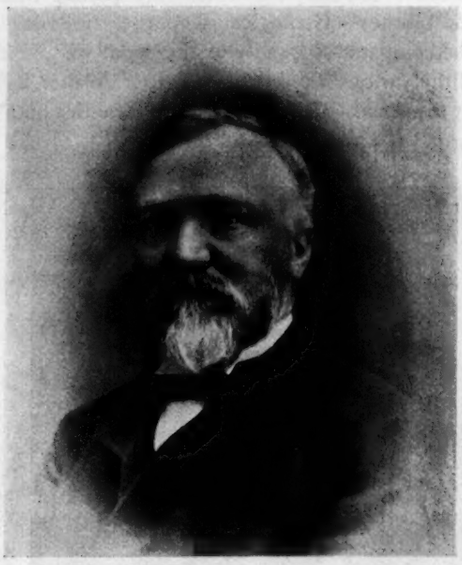
The most rapid advances in the near future, I believe, will be made in these two lines, until the foundryman shall arrive at that point of perfection and economy of production which the steel manufacturer and pig iron producer have already attained.

THE three black plate mills of the Morton Tin Plate Co., Cambridge, O., were put into operation Dec. 26. Exactly four months and six days were occupied in completing the plant, which is modern in every particular. During the first three days of manufacturing operations nearly 50 tons of black plates were produced. These mills are being operated on a union basis, non-union mills having secured all other desirable men. The company had an opportunity to select the best of the locked-out tin mill workers at Irondale, O., Demmler, Pa., and Bridgeport, O., and secured the services of experts. The class of work was very satisfactory but it will require very close watching to make a profit, considering the high priced labor and the extraordinarily low prices rew ruling for black plates.

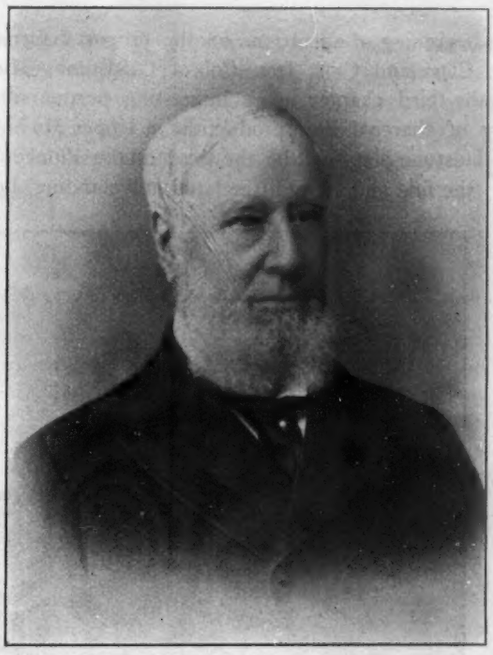
IT is proposed to hold the 68th meeting of the American Institute of Mining Engineers in Florida. The plan is to adjourn the annual meeting of February, after the transaction of formal business, from the office at New York to Jacksonville or Ocala, Fla., where sessions will be resumed on March 26. The meeting would then be continued in sessions at various points in Florida, combined with a tour of the State, including visits to the leading typical phosphate mines on the West Side and to the famous watering places at Tampa Bay, Punta Gorda, etc., followed by a trip including St. Augustine, the Indian river and Lake Worth on the East Side. It is expected that the sessions and the visits to the mines will be over in one week and that the remaining tour through the East Side will occupy a second week.

THE Cincinnati Rolling Mill Co. has thrown out the gear wheels at its Riverside plant and has substituted direct motion. A new shaft is being placed in position, also a fly-wheel 35 feet in diameter, weighing 50 tons. This is probably the largest fly-wheel in the country, though not the heaviest.

THE sheet mills of the Cambridge Iron & Steel Co., Cambridge, O., are closed down for annual inventory after a very steady run. It is expected that operations will be resumed this week.



ANDREW CARNEGIE.



B. F. JONES.

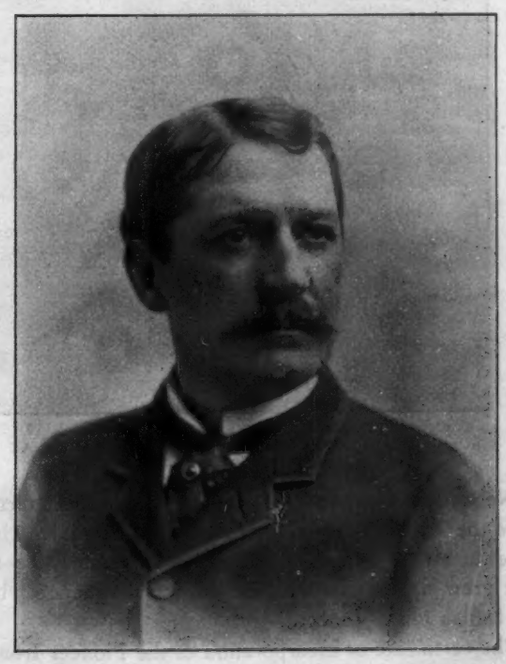
FOUR PITTSBURG STEEL MASTERS.

We are glad to be ab'e to present portraits of four well known representatives of the steel-making interests centered in Pittsburg. While Mr. Carnegie's name does not appear officially any longer, in connection with the great establishments which he spent a life-time in building up, his personality is indissolubly linked to these mammoth enterprises, and it is difficult to think that any other name will ever stamp itself upon them. Mr. Frick, though coming first into the public eye through his connection with the important interests of the Connellsville region, has for the past three years been the executive head of the Carnegie Steel Co., Ltd.—a period that has been marked by some of the most notable changes in economizing methods in the company's history. In a recent official statement it was shown that in the Homestead plant alone close to $4,000,000 in improvements has been expended since 1892.

Mr. B. F. Jones' chairmanship of the National Republican Committee for a number of years and his long connection with the American Iron and Steel Association as its president, are well known. He is chairman of Jones & Laughlins, Ltd., whose American Iron and Steel Works are second only to those of the Carnegie Steel Co., Ltd., in size and variety of product.

Henry W. Oliver, president of the Oliver Iron & Steel Co., Pittsburg, and of the Rosena Furnace Co., New Castle, is also closely allied with other Pittsburg interests. He was the first Pittsburg steel maker to acquire an interest in the Mesabi range and his mine, the Mesabi Mountain, commonly known as the "Oliver" is one of the most important producers on the new range.

H. C. FRICK.

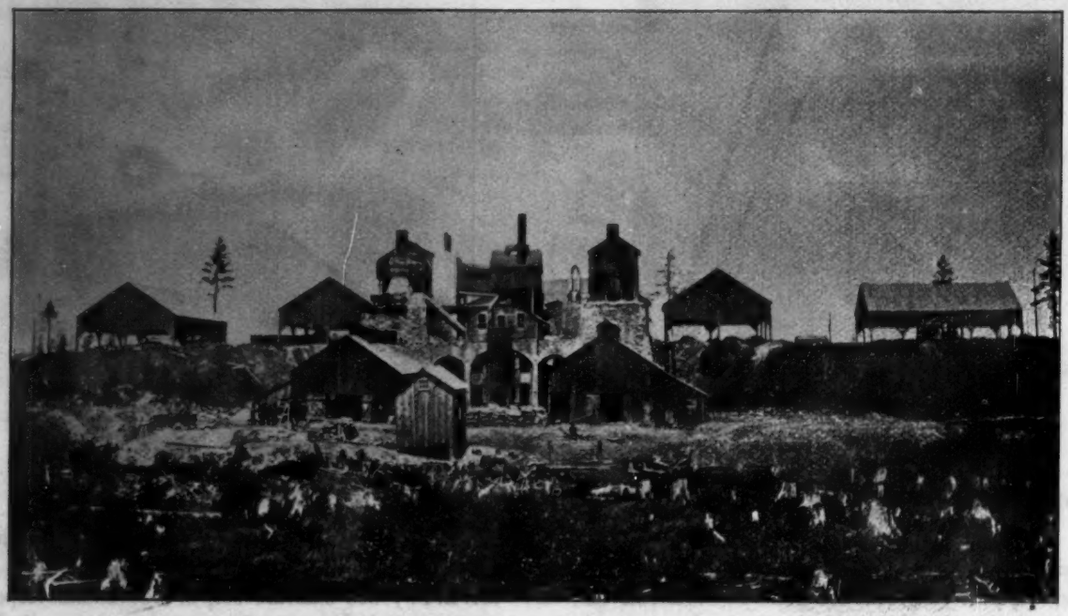


HENRY W. OLIVER.

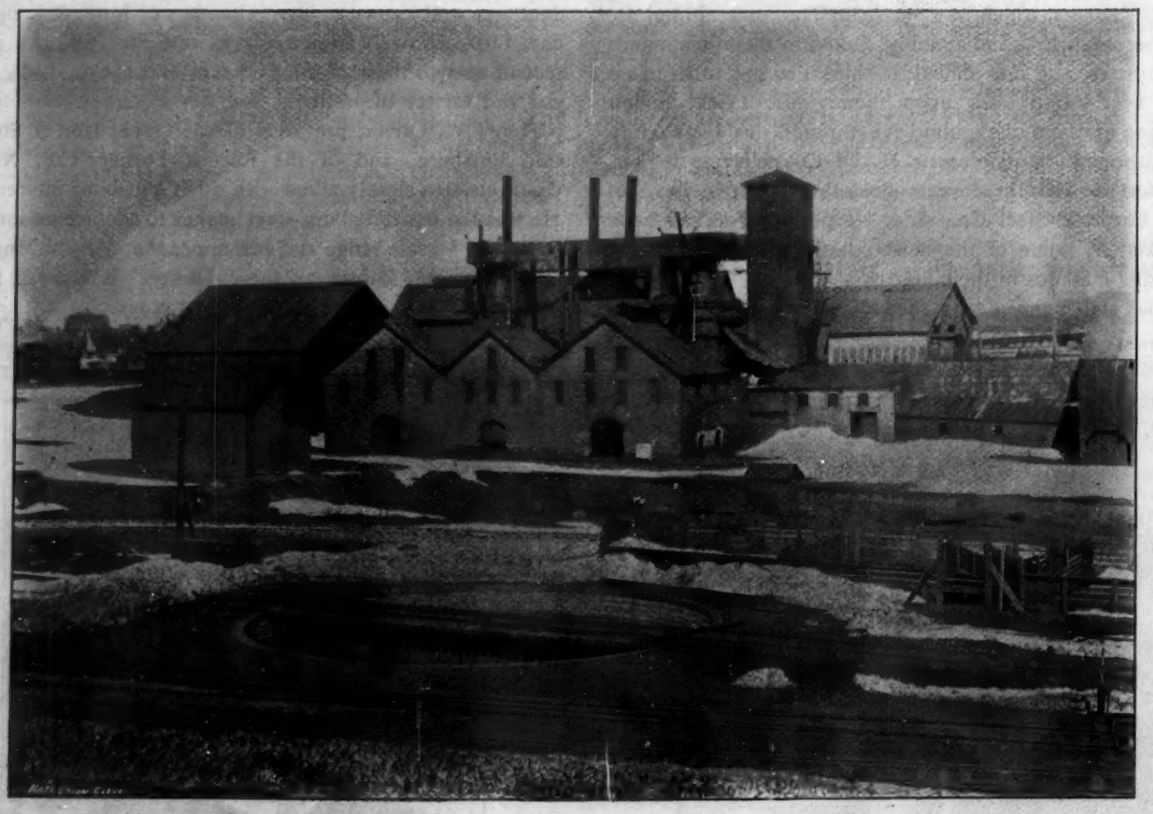
THE PIONEER FURNACES.

The beginning of operations on the proposed furnaces of the Cleveland Cliffs Iron Co. at Gladstone, Mich., opens the third chapter in an interesting portion of the history of charcoal iron production in Upper Michigan. The Gladstone plant will be the third of the Pioneer furnaces; the first and second (the latter still standing) being at Negaunee. The fact that the original Pioneer furnaces were the first for the making of charcoal iron in Michigan gave them their name, and the furnaces named the town that grew up about them, the word "Negaunee" being the Indian for "pioneer."

The certificate of incorporation of the Pioneer Iron Co. was issued from Lansing, Mich., April 8, 1857. The circular to the stockholders calls attention to the quality of iron made from Lake Superior ores (in the Catalan forges that preceded the charcoal furnace) by quoting from Foster and Whitney's Geological Report as follows: "To show the comparative quality of this iron, we give the results of the various experiments of Prof. Walter R. Johnson, on the tensity of bar iron, from localities both home and abroad:



ORIGINAL PIONEER FURNACES AT NEGAUNEE, MICH., BUILT 1858–59.

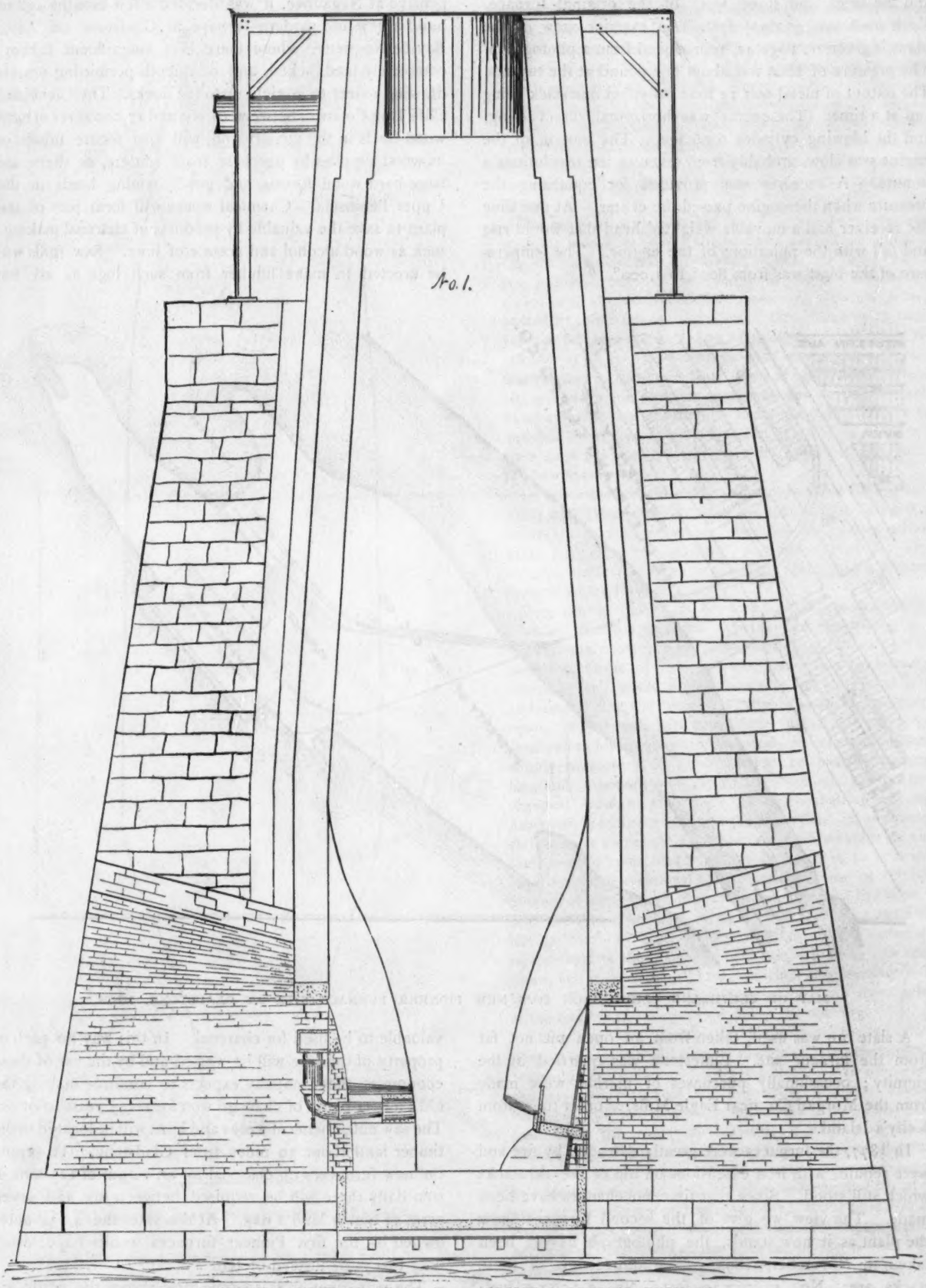


SECOND PIONEER FURNACES AT NEGAUNEE, MICH., BUILT 1877—NOW STANDING.

					Strength per sq. inch, lbs.
Iron from	Salisbury, Conn.,	by means of	40	trials.....	58,009
" "	Sweden,	"	4	"	58,184
" "	Centre Co., Pa.,	"	15	"	59,400
" "	Essex Co., N. Y..	"	4	"	59,962
" "	England (cable bolt),	"	5	"	59,105
" "	Lancaster Co., Pa.,	"	5	"	58,661
" "	Russia,	"	5	"	76,069
" "	Marquette, L. S.,	"	1	"	89,582

The circular then goes on to state that the company controls 4,134 acres of timber land which "at the usual estimation that a cord of wood will produce 40 bushels of charcoal, of which 125 bushels will furnish fuel to melt one ton of iron; and assuming that each acre will yield 60 cords of wood, the company's lands will furnish fuel for nearly 80,000 tons of iron or sufficient to supply two stacks for ten years." It was estimated that the cost of making iron would be $19.75 delivered at Chicago, and the cash price for charcoal pig being then $38 the profit would be $18.25 per ton. With this very encouraging prospect the directors felt bold enough to announce that they intended to erect in that year (1857) one stack capable of turning out 10 to 12 tons daily.

But all these pleasant predictions were falsified by the report in September, 1859, stating that beside the capital fully paid in of $125,000, a floating debt of $95,000 had accumulated, and that they were losing money on every ton of iron turned out. The fine quality of this old charcoal iron, however, is well shown by the fact that there



SECTIONAL VIEW OF STACK No. 1, ORIGINAL PIONEER FURNACE.

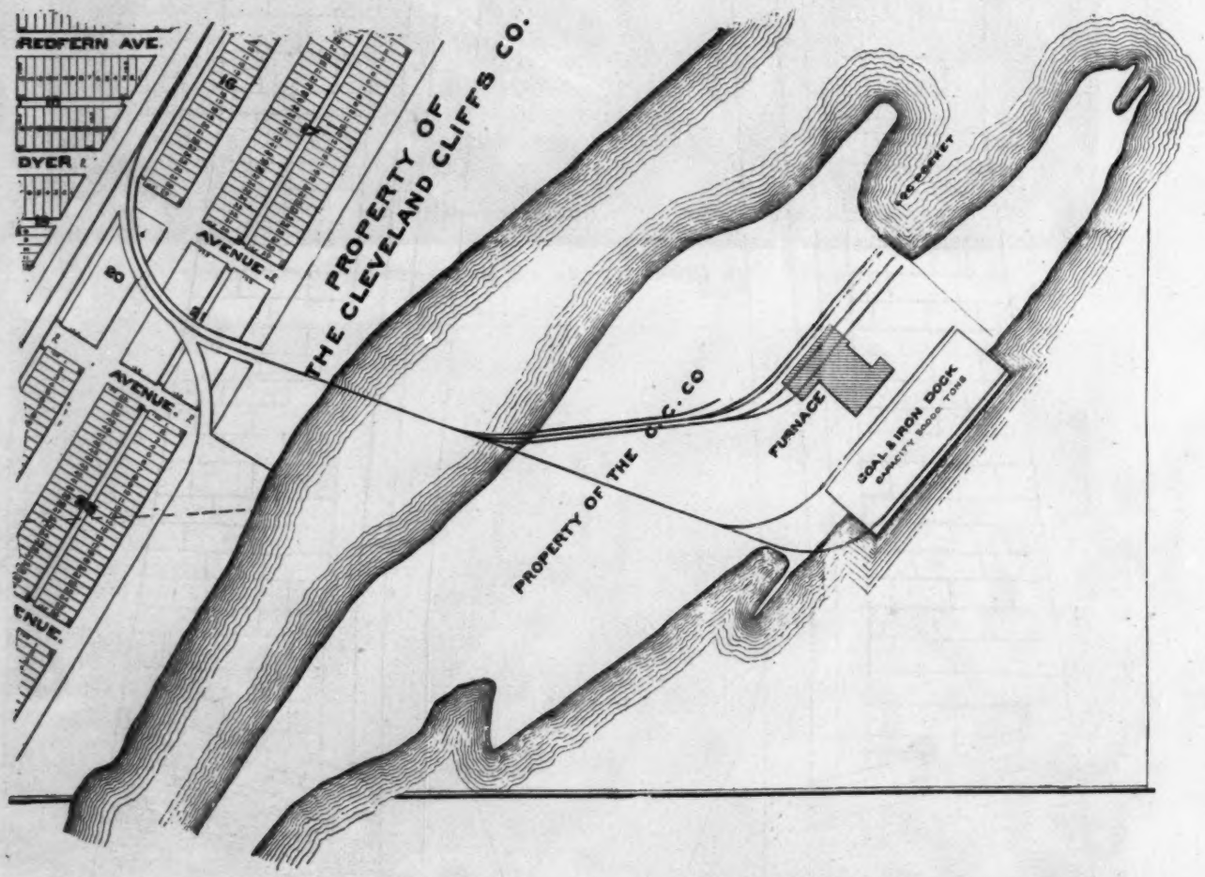
are car wheels made from it now in use on the Duluth, South Shore & Atlantic Railroad, that have been in continuous service for over 25 years.

No. 1 stack was built in 1858 and No. 2 stack in 1859. The cuts given in this connection show the furnace lines and the brick and stone work of the original furnace. Each stack was 40x9½ feet. An exterior view of the plant is given on page 42, reproduced from a photograph. The pressure of blast was about one pound at the tuyeres. The output of metal was 12 tons daily, but one stack being run at a time. The engine was horizontal, direct-acting, and the blowing cylinder 6x6 feet. The motion of the engine was slow, probably from seven to ten revolutions a minute. A receiver was provided for equalizing the pressure when the engine passed the center. At one time the receiver had a movable weighted head that would rise and fall with the pulsations of the engine. The temperature of the blast was from 800° to 1,000°.

A slate ore was used, taken from an open pit not far from the furnace site. Limestone was quarried in the vicinity; occasionally purchases of marble were made from the Morgan Co. near Eagle Mills, at other times from Kelly's Island.

In 1877, the furnaces were greatly damaged by fire and were rebuilt, with iron extensions on top of the old stacks which still stood. Since that time no changes have been made. The view we give of the second furnaces show the plant as it now stands, the photograph having been taken in November, 1894. The dimensions of these stacks are: No. 1, 56x10 feet; No. 2, 56x9 feet. Over 90 tons a day has been made by No. 1. On May 18, 1893, the furnaces were blown out and have since been idle. At the final suspension of operations the product was selling for less than half the price of the iron first turned out. Such of the equipment at Negaunee as can be utilized in the new plant at Gladstone will be removed at the dismantling in the coming year.

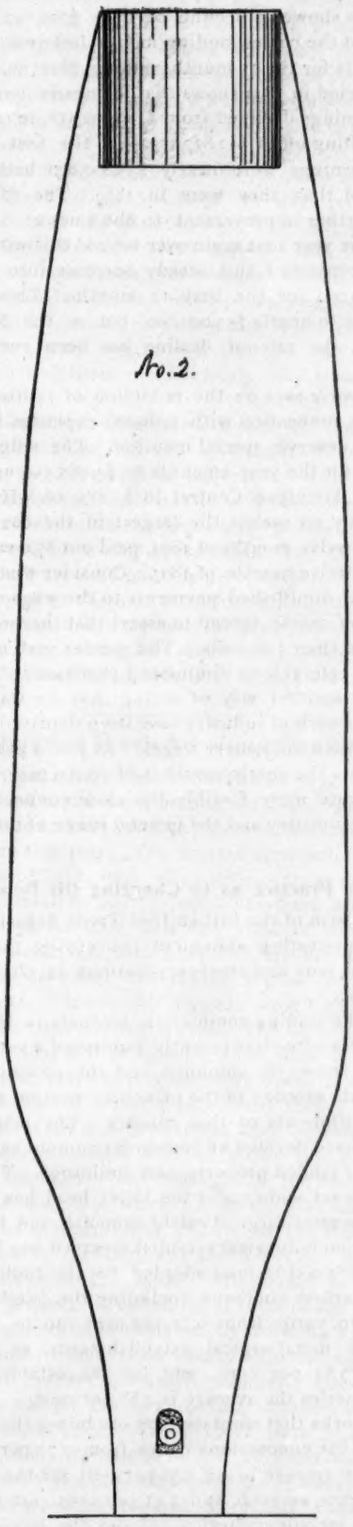
The last stage in the history of this pioneer Michigan furnace is now in progress. The plant now standing idle being antiquated, and charcoal having become too expensive at Negaunee, it was decided a few months ago to build a new and modern furnace at Gladstone on Little Bay de Noquette, where there is a magnificent harbor, completely land-locked, and of a depth permitting vessels drawing 20 feet to go right up to the docks. The Cleveland Cliffs Iron Co. owns between 16,000 and 17,000 acres of hard wood lands in the vicinity and will also secure much of its wood supplies by purchase from settlers, as there are large hard wood forests and good farming lands in the Upper Peninsula. Chemical works will form part of the plant to save the valuable by-products of charcoal making, such as wood alcohol and acetate of lime. Saw mills will be erected to make lumber from such logs as are too valuable to be used for charcoal. In this way no part or property of the tree will be wasted and by the use of these economies the company expects to continue making the old Pioneer brand of charcoal iron for many years to come. The saw mill, chemical works and kilns will be located in the timber land about 30 miles from Gladstone. To supply the new furnace with charcoal for an output of 125 tons of iron daily there will be required between six and seven acres of timber land a day. At this rate, the 4,134 acres owned by the first Pioneer furnaces would have lasted only two years instead of ten.



MAP OF CLEVELAND CLIFFS IRON CO.'S NEW PIONEER FURNACE SITE AT GLADSTONE, MICH.

The map given in this connection shows the island annex to the city of Gladstone and the plan of the new furnace plant, docks, tracks, etc., located on the island. A portion of the city map is also given, to show the relation of the furnace site to the city. The facilities of the furnace company in this new location could scarcely be im-

proved. Another advantage which Gladstone affords is the market furnished by the wood-working industry building up there, for the lumber that will be produced by the saw mills of the furnace company. Work on the new dock has been in progress for some time, and a railroad is



LINES OF STACK No. 2 PIONEER FURNACE.

being built by the Minneapolis, St. Paul & Sault Ste. Marie line. It is expected that the plant will be well along toward completion by the end of the present year.

THE tin plate plant of the St. Louis Stamping Co., St. Louis, Mo., is now running full on a non-union basis, and turning out plate equal to anything it has ever produced.

THE PIG IRON MARKET IN 1894.

Rogers, Brown & Co., of Cincinnati, furnish the following review of the pig iron market in 1894, touching on coke iron in general and in their price summary referring particularly to Southern irons :

A review of 1894 is not a pleasant exercise. While there has been an improvement in the output of pig iron, there has been no improvement in prices. We began the year with a weekly product of coke furnaces of 81,850 tons, and ended it with a weekly output of 150,368 tons. Stocks on hand declined from 437,000 tons in January to 210,000 in September and increased to 289,000 in December. This it will be seen is only about two weeks supply if all the furnaces in the country were simultaneously closed. It is thought that the increase of production has reached its limit until there is some improvement in price.

The range of prices during the year has been downward, with the exception of one or two short periods of active buying, which temporarily stimulated values. Alabama coke iron No. 2 foundry started the year at $11.00 at Cincinnati, and ended at $9.25. Of this decline, however, 50 cents is represented by reduction of freight rate. Gray forge on the first of January last was worth $10,00 at Cincinnati, and today is obtainable at $8.50. The lowest point of values in Southern iron was reached in April and May, when $7.00 at Birmingham for No. 2 foundry and $6.00 for gray forge was shaded. Prices advanced during the summer 50 cents per ton on heavy sales, and this improvement maintained until October, since which time there has been a further decline nearly if not quite, to the late Spring figures.

In Bessemer iron also, the lowest points were reached in April and December. In May the coke strike stopped production, stocks were quickly absorbed and prices advanced $3.00 per ton. The advance was maintained for several months, until the large production again broke figures to $9.65 at Valley furnaces.

Forecasting the future, it would be easier to express hopes than well founded opinions. The general expectation is that the extremely low prices prevailing will stimulate consumption of all forms of iron and steel, and this increased consumption will affect prices favorably, as soon as it is once understood that the demand is reliable and can be depended upon. It is argued with much force that if American values continue as low as they are, American makers must ultimately supply consumers in foreign countries, outside perhaps of England, Germany and Belgium, which are the centers of cheapest foreign production. The cheapening of cost of American machinery through the reductions in raw material and labor, is also enabling American manufacturers to extend their foreign trade, and that they are doing so to a considerable degree, is evidenced by the fact that some of the largest makers of iron and wood making machinery in the West, now find their best trade in foreign countries. The inability of the railroads to place orders for much needed material and equipment, is the heavy weight that is holding the market down, and it is difficult to foresee when this pressure will be lifted. The prospect in this direction does not seem as bright at the close of the month as it did at the opening.

There are some comforting features to the situation in spite of low prices and narrow margins. Manufacturers have learned in the school of hard necessity, the arts of increasing capacity, reducing cost and improving product. These advantages will tell materially when the turn comes. In the main also, the iron trade has suffered little from losses by failures. The experience of one large pig iron distributing firm covering every part of the country, was an average loss to furnaces represented of less than one twenty-fifth of 1 per cent. of the volume of business done. If the new year equals the old in this respect, it will be fortunate. On the whole the attitude of the trade at the opening of 1895 is one of hope tempered with abundant patience.

THE production of pig iron in Belgium for the month of November, 1894, amounted to 77,100 tons, as against 61,050 tons in November, 1893. Total production for 11 months 1894, 825,040 tons as against 644,990 tons for the corresponding period of 1893.

PRICES OF IRON AND STEEL.

Monthly Averages in the United States in 1893 and 1894.

In the following table we give the average monthly prices of leading articles of iron and steel in Pennsylvania markets in 1893 and 1894 per gross ton of 2,240 pounds, except for bar iron, which is quoted by the hundred pounds. The monthly averages are obtained from weekly quotations.

Months.	Old iron T rails, at Philadelphia.	No. 1 anthracite foundry pig iron, at Philadelphia.	Gray forge pig iron, at Philadelphia.	Gray forge pig iron, lake ore, at Pittsburgh.	Bessemer pig iron, at Pittsburgh.	Steel rails, at mills in Pennsylvania.	Steel billets, at mills at Pittsburgh.	Best refined bar iron from store, at Philadelphia.	Best refined bar iron, at Pittsburgh.
1893.									
January	$18 00	$14 80	$13 10	$12 30	$13 59	$29 00	$21 75	$1 80	$1 59
February	18 50	14 75	13 00	12 25	13 51	29 00	21 56	1 80	1 56
March	18 00	14 69	13 00	12 25	13 75	29 00	22 34	1 75	1 57
April	18 00	14 58	13 00	12 25	13 86	29 00	22 72	1 75	1 55
May	17 50	14 85	13 00	12 25	13 51	29 00	21 69	1 75	1 55
June	16 62	15 00	13 00	12 25	13 50	29 00	21 87	1 75	1 52
July	16 00	15 00	13 00	12 00	13 21	29 00	21 37	1 70	1 52
August	16 12	14 50	12 94	12 00	13 08	29 00	20 62	1 70	1 50
September	15 62	14 33	12 58	11 69	12 19	29 00	19 19	1 65	1 50
October	14 80	14 20	12 25	10 87	11 60	27 50	17 94	1 60	1 40
November	14 00	13 75	12 00	10 66	11 46	25 00	17 31	1 60	1 35
December	14 00	13 75	11 94	10 44	11 17	24 00	16 87	1 55	1 35
1894.									
January	13 00	13 37	11 56	9 88	10 90	24 00	16 10	1 55	1 30
February	12 62	13 00	11 37	9 72	10 75	24 00	15 94	1 50	1 25
March	12 50	13 00	11 00	9 61	10 56	24 00	15 46	1 45	1 20
April	12 12	12 60	10 75	9 47	10 49	24 00	15 69	1 40	1 20
May	12 00	12 50	10 50	9 55	12 44	24 00	17 75	1 30	1 25
June	11 62	12 50	10 56	9 78	13 15	24 00	18 60	1 30	1 25
July	11 30	12 50	10 50	9 94	12 60	24 00	17 75	1 30	1 20
August	11 50	12 50	10 50	10 00	12 12	24 00	17 75	1 30	1 17
September	11 50	12 50	10 50	10 02	11 53	24 00	17 30	1 25	1 17
October	11 50	12 50	10 50	9 84	11 02	24 00	16 00	1 25	1 15
November	11 75	12 50	10 50	9 72	10 66	24 00	15 49	1 20	1 15
December	12 00	12 50	10 50	9 47	10 31	24 00	15 11	1 25	1 10

Quotations for some of the articles named in the above table were lower at the close of December than at any other time during that month. Bessemer pig iron at Pittsburg was quoted at $10.40 early in December and at $10.25 at the end of the month, and Bessemer billets had fallen from $15.30 on December 1st to $15 on December 21st. Steel rails for delivery during 1895 were quoted at $22 all through the month, but for 1894 delivery the price was $24.

The bar-iron quotations given in the table are for the best quality of refined bar iron made from all-muck bars. Common qualities of bar iron have been sold for some time at Pittsburg for one cent per pound and even less.—[Bulletin.

THE interests of the firms of Shoenberger & Co. and Shoenberger, Speer & Co., Pittsburg, with 1,500 shares of stock of the Juniata Coke Co., 492 acres of coal land, etc., are taken in by the Shoenberger Steel Co., just incorporated with a capital of $1,800,000. The entire property is valued at $1,845,000. The directors are Charles L. Fitzhugh, Gottlieb A. Steiner, and Henry Fitzhugh, Allegheny; John Z. Speer and J. Ramsey Speer, Pittsburg. Charles L. Fitzhugh, as the executor and trustee, under the will of J. H. Shoenberger, has subscribed 7,060 shares of the 18,000; C. L. Fitzhugh, 3,305; John Z. Speer, 3,305, and G. A. Steiner, 2,760.

A YOUNGSTOWN special says that the Union Iron & Steel Co. and the Mahoning Valley Iron Co. have presented a proposition to the puddlers guaranteeing them steady work in the next four months if they will accept a $3 rate. Heretofore $4 has been paid and the mills have been run just as orders have come in, the men making only part time. If the new arrangement is made the mills will pile their product, if the market does not take it up. The local Amalgamated Association lodges will act on the proposal at once.

MR. D. T. MALLETT, owner and editor of the *Hardware Dealer*, a monthly magazine for retail hardware dealers, published in New York, is one of the brightest trade paper men in the country. His paper is always full of clever ideas which commend themselves to the reader and the printed matter continually sent out in the interests of the *Hardware Dealer* is original and up-to-date.

WHY THE RAILROADS ARE LIGHT BUYERS.

The *Financial Chronicle* presents figures concerning railroad earnings that indicate some betterment in that direction, while they show how tremendous has been the falling off in 1893 from the earnings of a prosperous year. It reports that during November the receipts of railroads controlling over 100,000 miles showed a decline of only $730,190 as compared with those of the corresponding month last year. A comparison of reports for the 11 months ending Nov. 30, 1893, and for the same period in 1894 shows that for nearly 100,000 miles of road the earnings declined from $489,002,518, in 1893, to $436,176,239, a falling off of $52,827,279. In the first 11 months of 1890 the earnings were nearly $35,000,000 better on 87,000 miles of road than they were in 1889. The following year showed a further improvement to the amount of nearly $30,000,000. The year 1892 again over-topped this with $25,000,000. Last year converted this steady increase into a decline of about $6,500,000 for the first 11 months. This year swelled that decrease to nearly $53,000,000, but as the November report shows, the rate of decline has been very noticeably checked.

The *Chronicle* says on the reduction of railroad expenses: "One fact in connection with reduced expenses has a general bearing and deserves special mention. The reduction on the Lake Shore for the year amounts to $3,965,534, and the reduction on the Michigan Central to $3,115,000. Here, then, are two roads—by no means the largest in the country—which, during the twelve months of 1894, paid out $7,000,000 less than during the twelve months of 1893. Consider what this means in the way of diminished payments to the wage-earning class. We do not, of course, intend to assert that the two roads saved that much in their pay-rolls. The greater part of the whole, no doubt, is referable to diminished purchases of supplies, but that is only another way of saying that the wage-earners in some other branch of industry have been deprived of the whole or a part of their customary wages. At $700 a year the $7,000,000 represents the yearly earnings of 10,000 men. Could anything illustrate more forcibly the close connection between the railroad industry and the general range of industries."

German Practice as to Charging Off Depreciation.

A late bulletin of the British Iron Trade Association has the following interesting statement concerning the practice of German coal, iron and steel corporations in charging off for depreciation:

"One of the leading commercial journals in Germany—the *Frankfort Gazette*—has recently published a very interesting table which shows the amounts, and the percentages, of the sinking funds adopted in the principal mining and metallurgical establishments of that country. The majority of the companies have devoted an important amount to the depreciation of their landed property and buildings. The average of the amounts set aside under the latter head has been 2.14 per cent. for the metallurgical establishments, and for the united mining and metallurgical establishments it has been as much as 2.96. The sinking fund adopted for the buildings belonging to the various concerns, including the dwelling houses of the workmen, varies from 0.77 per cent. up to 7.70 per cent., but for the metallurgical establishments, as a whole, the average is 2.85 per cent., and for the establishments that include collieries the average is 2.88 per cent.

"In the works that embrace iron ore mines the sinking fund adopted for the concessions varies from 0.77 per cent. to 15.60 per cent., the average being 4.59 per cent. for the metallurgical establishments, as such, and 3.43 per cent. for the establishments that include collieries. Under the head of constructions, for mines and mineral workings, the sinking funds vary from 0.77 per cent. to 15.60 per cent., the average being 5.45 per cent. for iron and steel works, properly so-called, and 3.43 per cent. for the works associated with coal mines. The amount of the sinking funds provided for patents, models, etc., is not made known in all cases, but, so far as the figures go, they appear to show that the amount set aside for depreciation under this head is very large, the average being as much as 37.10 per cent. In addition to the sums named, some of the leading works have set aside considerable amounts for pensions, etc."

THE END OF TWO BAD YEARS.

This country has just passed through two of the most disastrous business years in its history. We need not dwell upon the financial troubles, the industrial distress, the criminal blundering in high places which happened in these two years. The world knows these things by heart.

The calamitous consequences to the iron trade of our country of the general business depression of 1893 and 1894 are only in part told by the table of continually falling prices which is printed on this page. The closed mills and furnaces and mines, the many bankruptcies, the thousands of idle workmen, and the low wages for those who have been employed must be added to complete the story. Other industries have fared but little if any better.

For the iron trade there is to-day the hopeful view that the demand for iron and steel, except for steel rails, is much larger than it was a few months ago, and that prices have fallen so low that they can scarcely fall any lower. Taken together these two conditions give support to the theory that prices must soon advance, and when prices begin to advance consumption will increase, reversing the usual rule. An advance in prices should begin with iron ore and coke. The producers of each of these raw materials may combine to put up prices.

There is another view, which is not favorable. Congressional tariff tinkering has been followed by Congressional currency tinkering, the end of which is uncertain. Until this fresh agitation is ended, which may not be very soon, there must be more or less apprehension concerning the business future.

Our own judgment is that, notwithstanding the evil consequences of the new tariff and the disturbed condition of the national finances, the business situation must from this time forth gradually improve. We look for more industrial activity in 1895 than in 1893 or 1894, but at prices for finished products not very much above the terribly low figures which now prevail.—[Bulletin.

Largest Shipping Week for Connellsville Coke.

Shipments of coke from the Connel sville region were the heaviest on record in the week ending Dec. 22. The *Courier* says: "Coke production passed the 150,000 ton mark last week for the first time this year. The nearest approach to it before was in the week of Sept. 22nd, when with 15,514 ovens in blast production amounted to 149,775 tons. There are not as many ovens in blast now as then, but the yield of coke is much heavier. Last week was also a record breaker in output. Nearly 8,300 cars were sent out of the region to the various consuming points. This is the biggest week's shipments in the history of the Connellsville region. The total production of the region for 1894 will be greater than that of 1893. In December last year there were about 8,500 ovens in blast, producing on an average of 80,000 tons a week. Since then the number of active ovens and production have almost doubled. During April, May, June and July the strike kept production down to a very low figure and was partly the cause of the boom in demand that has since followed. The low price of coke has been the disappointing feature of the trade during 1894. The prospects for 1895 are much better. If there is any change it will be for the better. Prices can go no lower than they are at present. The efforts of some of the coke men to raise the price the first of the year by forming a syndicate have failed, at least for the time being. The ruling rate will continue through January and possibly longer. The condition of the iron trade will be the key to the situation in this region." In the week under review there were 14,424 active ovens, and 3,390 idle. Estimated output of those active, 151,462 tons, an increase of 4,610 tons over the preceding week. Shipments for the week aggregated 8,276 cars, consigned as follows: To Pittsburg and river tipples, 2,618 cars; to points west of Pittsburg, 4,008 cars; to points east of Connellsville, 1,650 cars. Compared with the shipments of the previous week, this was an increase of 455 cars.

SEVENTEEN firms of manufacturers of bar iron, east of the Allegheny Mountains, met in Philadelphia Dec. 27 to consider the condition of the trade. A committee to revise the list of extras was appointed. The next conference was appointed for Jan. 3.

STATE OF THE WELSH TIN PLATE TRADE.

There are further 10 per cent. concessions in wages by employes in Welsh tin plate works, but the question does not seem to settle itself very fast. We quote from the Swansea market review of the London *Iron and Steel Trades Review* of Dec. 22:

"Owing to the non-arrival of vessels, through the tempestuous weather, the shipments of tin plates during the week only amounted to 42,999 boxes. There are, however, a large number of steamers due to load, and the next return will probably show a heavy export. The receipts from works since last week have been 75,173 boxes, so that stocks have been increased by about 33,000 boxes. They now stand at 282,459 boxes, as compared with 238,839 boxes at the corresponding date of last year. There was a large attendance on 'Change on Tuesday, but the business done was of a hand-to-mouth character. Prices still continue to decline. Bessemer cokes, C 14 by 20, can, with difficulty, be sold at 9s. 6d., buyers, in many instances, refusing to give more than 9s. 4½d. C 18¾ and 19¼ by 14 changed hands at 9s. 7½d. Siemens cokes, C 14 by 20, were quoted at from 9s. 9d. to 10s., but the latter figure was unobtainable, and to do business the difference had invariably to be split. C 10 by 20 cokes were sold at from 13s. 10½d. to 14s. Charcoal tins are 10s. 6d. and upwards, and ternes, per double box, 18s. 6d., and upwards.

"The wages question is still unsettled. A private meeting of the Council of the Tin Plate Workers' Union was held at Cardiff on Saturday, at which it was decided to relegate the question to the various lodges for decision. The executive committee are strongly of opinion that no reduction of more than 10 per cent. should be accepted, and that even at this figure contracts should not extend beyond the end of March next. In view, however, of the firm attitude adopted by the manufacturers in the Llanelly district, some of the tin plate workers there have expressed themselves in favor of a reduction of 15 per cent. They fear unless a compromise is arrived at soon, many of the works will not continue operations. In the Gloucestershire and Monmouthshire districts, the men are taking the matter into their own hands. At the works of Messrs. R. Thomas & Co., at Lydney and Lydbrook, they have agreed to accept a reduction of 10 per cent. for the next three months."

AT a meeting to reorganize the Eastern Bar Iron Association, held Dec. 20th at the rooms of the American Iron and Steel Association, Philadelphia, the following committee on extras was appointed: H. T. Wallace, secretary of the Diamond State Iron Co.; A. J. Steinman, of the Pennsylvania Bolt & Nut Co.; H. M. Clapp, of the Lebanon Iron Co.; and A. R. Whitney, of the Portage Iron Co., Ltd. The chairman was instructed to communicate with all mills east of the Allegheny mountains and obtain their views as to the proper extras to be charged over the base price and submit the same at the next meeting to be held on Thursday, Jan. 3, 1895, at the same place.

ROBERT G. BUSHNELL, who was for 25 years with Park Bros. & Co., of Pittsburg, died Friday, Dec. 28, at Morristown, N. J. He was a son of Daniel Bushnell, one of the pioneers of Pittsburg, and was 55 years old. He did much to bring the Park plant up to its high standard. In 1880 he removed to New Jersey, where he established the Jersey City steel works.

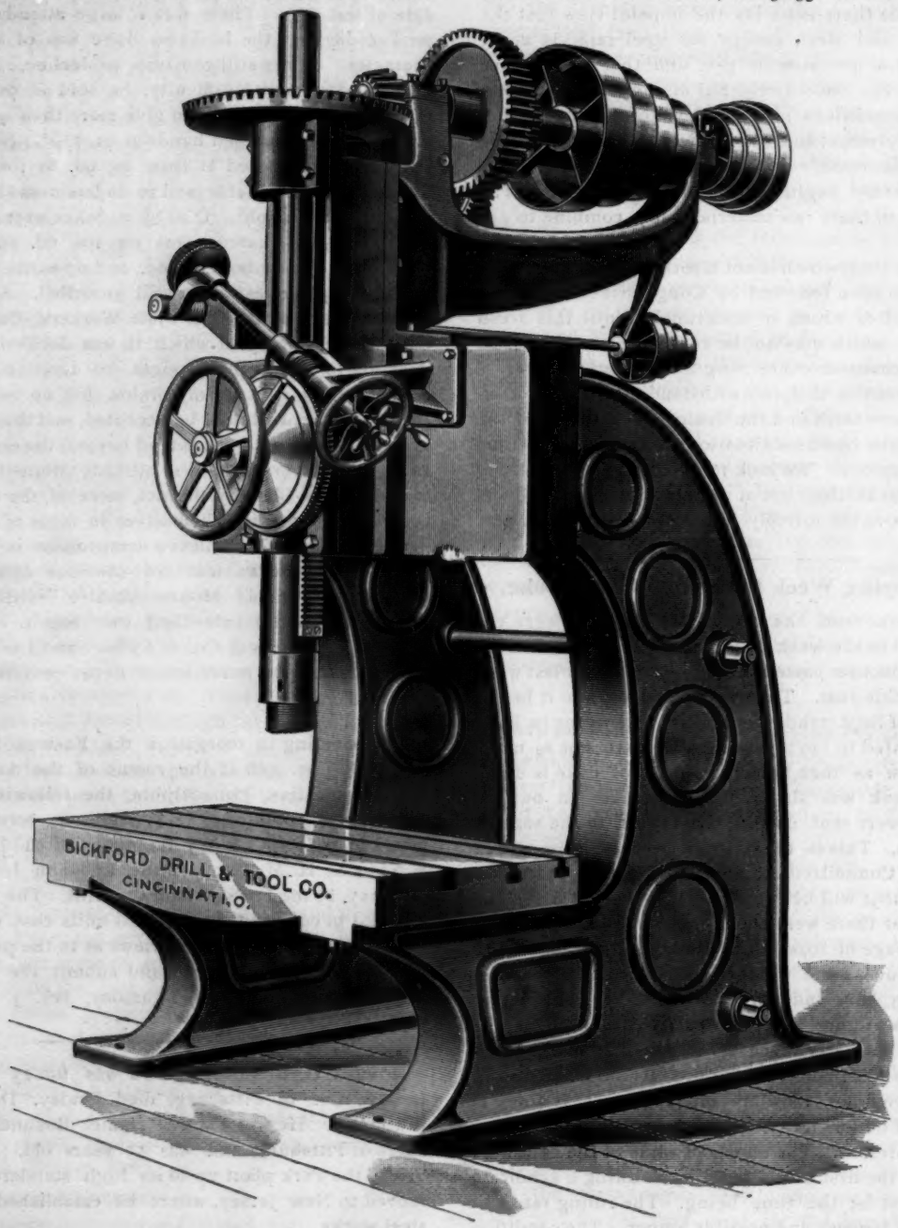
THE London *Economist* says that, of 22 staple commodities in England, 11 have fallen in price since the beginning of October, seven have risen, and four show no change. The decline is most marked in cotton, sugar, tin, indigo and wool, while a rise is recorded in timber, wheat and butchers' meat.

MATTHEW ADDY & Co., 556 The Rookery, Chicago, for whom Andrew Hawthorne is representative there, have been appointed sales agents for Hamilton coke pig iron and Pine Grove charcoal pig iron, both made from Hanging Rock ores.

THE effort to form an association of the makers of cold rolled steel in the United States has been definitely abandoned.

HEAVY BORING AND DRILLING MACHINE.

The accompanying illustration represents a new boring and drilling machine just placed on the market by the Bickford Drill & Tool Co., of Cinninnati. The machine is especially designed for boring heavy forgings and cutting out holes from solid steel plates. The construction of the tool is very heavy, and all parts are so proportioned that perfect satisfaction is secured in doing the heaviest work. The spindle is of forged steel, and has a taper hole in the end for large drills, likewise threads on the outside for tool holding heads. The spindle measures 6″ on the bottom, and 4″ on the top end. It is counterbalanced and has four changes of automatic feed, but can also be fed down by hand; quick return wheel or lever same as on our standard drills. The distance ibetween the housings on the machine shown is 3 feet, but this distance can be varied to suit the requirements of the case.



HEAVY BORING AND DRILLING MACHINE.

The ratio of the bevel gear and pinion is 4 to 7, the gear being 24″ in diameter, the pinion 6″ in diameter; both 3″ face and machine cut. The back gears are very heavy 4 and 3-pitch gears, with the ratio of 6½ to 1. The cone pulleys are 18″, 15½″, 13″ and 10½″ in diameter, and 4¾″ face. Tight and loose pulleys are 22″ diameter and 5″ face. The machine will weigh fully 9,000 lbs., and is guaranteed in all details.

A Great Year for Shipbuilding.

The *Bulletin* of the British Iron Trade Association gives returns of shipbuilding in British yards in the past year. The total is 1,324,671 tons, which is one of the largest shipbuilding records hitherto reached in any twelve months, and an increase of 336,000 tons on the shipbuilding work of 1893. The only year that exceeded the past twelve months in the amount of shipbuilding work turned out was 1892, when 1,452,907 tons were built, or 128,000 tons in excess of 1894. The Clyde yards lead, of course, with 340,885 tons, of which 268,755 tons is of steam and 72,130 tons of sail vessels. The total of steam tonnage is 1,189,524; of sail tonnage, 135,147.

A feature of the shipbuilding returns for 1894 to which attention is called in British journals is the increase of foreign-built vessels from a tonnage of but 71,326 in 1893 to 200,663 in the last twelve months. This table credits a tonnage of 99,554 to Germany for 1894, 6,923 to France and Spain, 4,866 to Austria, Italy and Greece, 16,154 to Russia, Sweden and Norway, 14,630 to Denmark and Holland, and 58 536 to the United States and Canada. This last return, it is explained, does not include the wooden vessels built on the lakes and rivers. It is questionable, moreover, if the steel vessels built for the lake trade have been included.

FORMAL notice is issued of the dissolution of the well known Chicago pig iron firm of Rogers, Brown & Merwin, Wm. A Rogers and Archer Brown retiring. Gaius S. Merwin has purchased the business of the firm. Announcement is also made by Gaius S. Merwin and Thos. P. Merwin that they formed a co-partnership on Jan. 1, 1895, to carry on the business of selling pig iron, coke and similar products. The new firm will conduct business at the offices formerly occupied by Rogers, Brown & Merwin, 1014 and 1016 Monadnock Block.

INCREASING USE OF OIL AS FUEL.

A development of the past few yerrs, and particularly of 1894, in connection with various departments of iron and steel manufacture, is the increasing use of oil as a fuel. In heating furnaces, forges, puddling furnaces and under boilers in all classes of manufacturing establishments, oil has been demonstrating its efficiency, economy and desirability on other accounts. It has been employed with success for melting brass in crucibles, for heating bolts and rivets; and in glass works, brick kilns, potteries, ovens, dryers, garbage crematories, and in the baking of plaster products it has been increasingly employed.

For use under boilers it has been found that the present method of burning oil will utilize all the heat units contained in the oil. One pound of coal represents about 14,000 heat units, and the best results obtained have utilized from 7,000 to 9,000 units, so that from 5,000 to 7,000 units are lost in gas that escapes through the flues. One pound of oil will evaporate under modern water tube boilers from 16 to 18½ pounds of water, temperature of water at the start, 85 degrees, while one pound of best coal under the same conditions will evaporate from 7 to 10 pounds of water—usually under horizontal boilers about six pounds of water.

Air and steam are both employed to atomize the oil, but there are good reasons for giving the preference to steam. The decomposition of the water under great heat results in separation into oxygen and hydrogen—giving a highly combustible gas and the greatest supporter of combustion. In the case of air the non-combustible nitrogen mingled with oxygen dilutes the latter and diminshes its energy. Yet in the case of steam, the heat required to disintegrate it is a factor to be taken into consideration. Repeated experiment and observation afford the only basis of determining with exactness the relative merits of the two system.

In expense of attendance, in the refuse produced, in the avoidance of smoke, and in cost of repairs experience has demonstrated that many advantages are secured through the use of oil. It has been found that by the best system of burning crude oil, from 100 to 110 gallons will do the work of a ton of best coal. The expense of repairs is very moderate—in most cases is scarcely an item. Another advantage is the steady maintenance of steam pressure without fluctuation. There is no necessity for opening the fire box doors and therefore the loss of heat with the in-rush of cold air is avoided.

In welding and heating the economy of oil has been emphasized in the recent experience of manufacturers operating forges. The fires do not need to be replenished and a steady heat is maintained. A saving of 15 per cent has been shown in such operations and a number of manufacturers are negotiating for oil burning systems on that basis.

It has been found that fires can be kindled in locomotives with crude oil at a cost of 3c. to 4c. The coal is ignited more quickly and steam is raised in one third the time required with wood, with only a fraction of the expense of the latter. Oil has been used successfully in running locomotives. Three tons of coal would be required to run an express train from Philadelphia to New York. The same result, it is claimed, can be accomplished on 300 gallons of crude oil at a cost of $7.50 against $11.40 for the coal.

An increasing use of oil is noted also in running steam ships, tugs and steam launches. Lake vessels and ocean steamers are employing it with good results.

New Management for the Whaleback Barges.

Arrangements are being made between the American Steel Barge Co., of New York, and Pickands, Mather & Co., of Cleveland, whereby the latter firm will act as operating agents for the barge company during the season of 1895. Details have not as yet been arranged, but it is understood that all the boats of the barge company on the lakes will next season be operated through the office of the Cleveland firm. The barge company now has on the lakes a fleet of twenty-six boats, of which six are steamers. The aggregate net registered tonnage of the fleet is 25,781, and the insurance valuation $2,600,000. Another steamer now building at West Superior will be added next season. The main object of this move on he part of the barge company is, of course, to secure the advantages of the ample facilities of Pickands, Mather & Co.—[Marine Review.

EVOLUTION OF THE ROLLING MILL.

The forge fire, first alone, and subsequently in connection with the finery or "run-out fire," made the early wrought iron in this country, the blooms or loupes being hammered into anchovies and bars; for rolls were not employed until 1750, and those used at that time were merely to slit the iron into bars of approximately uniform dimensions. The puddling and subsequent rolling of iron in the United States dates from 1816, but heavy rolling, such as that of railway iron and railroad tee rails, has been practiced for but half a century.

The advancement indicated in blast furnace construction and operation is repeated in the appliances and methods employed in the production of wrought iron, for the rolling mill of the present time is in marked contrast with the slitting mill or the more ancient bloomaries or forges, a few of which still remain, the latter now being employed mainly for "sinking" scrap or working pig iron for special uses. A well-equipped modern rolling mill with gas producers, furnishing fuel to puddling and heating furnaces, the waste heat generating steam in boilers to propel machinery operating squeezers, hammers, rolls, shears, saws, and various mechanical devices to reduce the manual labor, produces also a much greater quantity of wrought iron, in better finished shape, than resulted from the efforts of a larger number of workmen for a week in a forge, the blowers and trip hammers of which received motion from water wheels.

The processes and methods in use at large steel works are even more advanced than those employed at many iron rolling mills, and since the manufacture of steel has assumed great proportions and exhibited marked economies, there have been numerous prophecies that "the puddling furnaces must go," and that in this "steel age" there is small prospect for development in iron manufacture. Although numerous inventions for producing steel in small quantities have been introduced, the results cannot be considered satisfactory, and present practice indicates that to manufacture steel economically, it must (with the exception of crucible steel) be done on a liberal scale. On the other hand, the relative sizes of iron rolling mills does not affect to so great an extent the cost of production. In either case, a large output is advantageous in reducing the fixed charges per ton of product, but the equipment for making steel must, in its prominent features, be of such proportions as to demand continuous operation and large output in order to accomplish satisfactory results.—[John Birkinbine, in Cassier's Magazine.

Electric Motors for Machine Tools.

Six years ago, says *Industry*, we ventured the prophecy that machine tools would soon be operated by independent electric motors. The advantage of the system was as well known then as it is now, but all this time has been required for evolution and adaptation of the motors to the different tools. Some clumsy attempts have failed where motors were set on shelves around the walls, and sometimes on the floor alongside the machines, to be stumbled over and broken, but when properly arranged as an integral part of original plans, and for the heavier class of tools, there have been no failures. The expense of the system is mainly in maintenance of the motors; any workman can take care of a countershaft and driving bands, but for the motors and electric connections an electrician is required. This has been the main impediment; another one was in adaptation by that inflexible body, the tool makers, who seldom change anything until compelled to do so

THE co-partnership heretofore existing under the firm name of Naylor & Co., New York and Pittsburg, expired by limitation on Dec. 31, and has been dissolved. A limited partnership has been formed, beginning Jan. 1, under the firm name of Naylor & Co. in which Frederick L. Lehmann and J. Mitchell Clark of New York are the general partners, and Edward Ascherson and Alexander S. Hay of London, Theodore Dreier of Brooklyn, N. Y., and Edward J. Berwind of New York are the special partners. The new firm will conduct the liquidation of the late general partnership of the same name, whose unexecuted contracts it will assume and carry out, and will act as the sole agents in the United States and Canada for Naylor, Benzon & Co. of London.

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The First Manufactory of its Kind in the U. S.

Home Office and Works:—MOUNT SAVAGE, Allegany County, Md.

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HIGH GRADE FIRE BRICK for

Rolling Mills, Steel Works, Blast Furnaces, Cupola Linings, Boiler Settings.

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Our large capacity, 8,000,000 annually, and modern plant, enable us to handle contracts of any size promptly.

Ground or Calcined Clay in Sacks or Bulk.

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Progress in the South Since 1880.

Summarizing statistics gathered during the past 14 years—since 1880—the Baltimore *Manufacturers' Record* shows the following increases:

Railroad mileage, 1880, 20,612; 1894, 46,900. Yield of cotton, bales, 1880, 5,755,000; 1894, 9,500,000. Yield of grain, bushels, 1880, 143,000,000; 1894, 600,000,000. Coal mined, tons, 1880, 6,049,000; 1894, 30,000,000. Pig iron produced, tons, 1880, 397,301; 1894, 1,560,000. Number of cotton mills, 1880, 161; 1894, 425. Number of spindles, 1880, 607,000; 1894, 3,000,000. Number of looms, 1880, 14,323; 1894, 68,000. Capital invested in cotton mills, 1880, $21,038,712; 1894, $107,900,000. Capital invested in cotton oil mills, 1880, $3,504,000; 1894, $30,000,000. Number of cotton oil mills, 1880, 40; 1894, 300. Lumber sawed and planed, value of product, 1880, $46,938,100; 1894, $114,746,674. Lumber sawed and planed, capital, 1880, $26,902,644; 1894, $92,604,375. True value of property as per census report, 1880, $7,641,000,000; 1894, $11,534,260,000. Farm assets, 1880, $2,314,000,000; 1894, $3,182,000,000. Value of farm products, 1880, $666,000,000; 1894, $850,000,000. Capital invested in manufacturing, 1880, $257,244,561; 1894, $800,000,000. Value of manufactured products, 1880, $457,454,777; 1894, $1,000,000,000.

Nearly 600 more enterprises were established in the South during 1894 than in the preceding year. The first quarter of 1894 developed 662 new enterprises. The first half of the year showed a total of 1,499; the last half of the year brought out 1,380, making the total for the year 2,829.

THE Junction Iron & Steel Co., Mingo Junction, O., makes the announcement under date of Jan. 1 that it has succeeded to the business of the Laughlin & Junction Steel Co., and that the name of the Junction Iron Co. has been changed to Junction Iron & Steel Co., with a largely increased capital stock. The company will continue the manufacture of the products of the former companies and at present has capacity for the production of Bessemer, foundry, and forge pig iron, soft Bessemer steel in ingots, blooms, billets and slabs, soft steel nail plate, suitable for shallow stamping, in such lines as shovels, seats for agricultural implements, spiders, skillets, and many other purposes. After Feb. 25th, 1895, the works will have additional facilities. Contracts are already placed for the machinery, and the company will be prepared to supply soft steel tin plate and sheet bars "boshed," and cut to any desired length, and rolled to any thickness from half inch up; also small steel billets from one and one-fourth inch, square or round, up to three inches. These billets will be raw materials for manufacture of street and railway cars, agricultural implements, bolts, wagon and carriage axles, and many other lines of iron and steel. H. M. Priest is president and general manager of the company and Geo. A. Dean, secretary and superintendent.

THE Oak Hill Fire Brick & Coal Co., whose extensive works are located at Oak Hill, O., has closed what was with it a busy and prosperous year, having operated its entire plant without interruption and its product given entire satisfaction to their customers. This company possesses many natural advantages. It owns large tracts of clay lands containing almost inexhaustible deposits of clay and coal, which are not surpassed for producing a superior article in high grade fire brick that will successfully withstand the most intense heat. The company's "OK." Crown brand is rapidly making a record for itself as a leading fire brick. It has been made for the past 22 years, with increasing demand from year to year. The company invite correspondence from dealers and large consumers as it is prepared to fill large contracts on short notice, at close prices, with quality always guaranteed.

THE Oakland Iron Works are to be rebuilt on a more extensive scale than before the fire there, and with improved provision for handling material and work. The machine shop will be 100x100 feet, divided into three "bays," each served by an overhead traveling crane to sustain fifteen tons, and by this latter arrangement of the cranes will save several thousand dollars a year in labor hire. We have seen a machine shop reached all over by light traveling cranes, where there were no laborers except to clean up. The men in charge of machine work, and fitting also, did not want any "lifters" in their way, and preferred to handle their own work when the tackle was available, and that was always, because there were several light cranes in each bay. These cranes were very simple, and could be drawn quickly by hand to any point on the floor.—[Industry, San Francisco.

THE Paige Car Wheel Co., 310 Hickox Bldg., Cleveland, have extensive works at the corner of Lake and Wason Streets, in that city, and are manufacturers of steel tired car wheels under the Paige patents, and of galvanized iron car roofs under the Winslow patents. They have a very large trade in the United States, and are doing an increasing business abroad.

THE tin plate plant of the St. Louis Stamping Co., St. Louis, Mo., is now running full on a non-union basis, and turning out plate equal to anything it has ever produced.

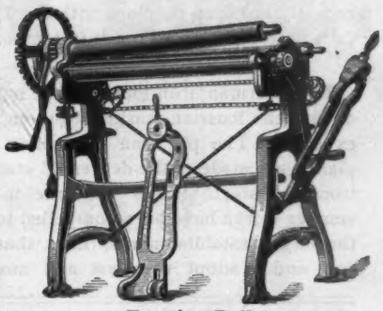
Machines for Working Sheet Metal.

Patent Gap Shears.

Patent Gap Shears, Especially designed for Squaring, Trimming and Slitting. 6 to 18 inch throat for Slitting Wide Sheets. Complete for Tin or Iron, to 14 gauge. Seven Styles of various lengths HAND AND POWER

General Purpose Punch and Shear. Seven Sizes.

Rear Side.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General Purpose Forming Rolls, all sizes. Quickly adjusted and instantly opened—A Revolution. Also Patent Crimping Rolls. Beware of Infringements.

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LIGHTNING LIFTING SCREWS. TAPER THREAD.

INDUSTRIAL NOTES.

The lower works of the Cambria Iron Co., with the exception of the blast furnaces, are closed for necessary repairs. The 48-inch blooming mill will be shut down three weeks for repairs. The company has decided to abandon the Archer fuel gas at the blooming mill and to return to coal-produced gas, arrangements for which are now being made. The gas by the Archer process was made from crude petroleum, and was introduced at the time of the failure of the natural gas four or five years ago. The natural gas is not now, and has not for some years, been used in any other department of the mills.

The rolling mill building of the Atlanta Steel & Tin Plate Co., Atlanta, Ind., is about completed. It is of iron, 80x300 feet. The company will be rolling its own black plates early in January.

The Crescent Sheet & Tin Plate Co., Cleveland, O, will begin the production of black sheets by April 1. The company will operate this department of the works first. Later on the manufacture of tin and terne plates will be taken up. The buildings now in course of erection are a steel hot mill building, 105x175 feet, and a combination building containing the annealing, pickling, cold rolling, tinning and warehouse departments, which will be all steel and brick, 105x168 feet, with a wing 48x48 feet. The buildings are being put up by the Shiffler Bridge Co., of Pittsburg. The Industrial Works, Bay City, Mich., have the contract for the supply of two electric cranes, and the Elwell-Parker Electric Co., Cleveland, will furnish a generator to run these cranes, together with 15 arc and 60 incandescent lights.

The Wais & Roos Punch & Shear Co., Cincinnati, have brought out a shearing machine for cutting packs of sheets in tin mills. The machine is built with or without engine, and with or without gearing. It is supplied with front, back, and side gauges. The standard length of blades is 40 inches, but it may be made wider if so desired. It is constructed with the view of compactness, strength, and rapid operation, which features have recommended it to many of the large mills of the country. The manufacturers are at present making eight of them for one plant, and they have also received orders for a new combined shear and doubler, sheet doublers, levelling rolls, etc.

The Bickford Drill & Tool Co., of Cincinnati, are having a good supply of orders and their shops are well filled with work. Since Oct. 1 business has been looking up among machinery manufacturers and the Bickford company have had a good increase, with the present outlook quite promising. They have made a shipment of one of their largest drills to London, Eng., and have an order for three of their large radial drills to go to South Africa. Considerable foreign business is pending with prospects of closing much of it. They are at work on some new designs for improvements in machine tools, to put before the trade as early as possible in 1895. Two lathes have been added lately to the company's shop outfit and an electric light plant put in. There are now 75 men at work on full time and the new year opens with good prospects of an increasing volume of business.

At Hammond, Ind., the Corning steel plant, which has been closed for three years, will be put in operation Jan. 10 with a single shift of men.

The Lloyd Booth Co., of Youngstown, O., has sold recently two of its well-known bar shears. This company now has in process of construction four 24x34-inch hot mills, four 22x34-inch mills and one 20-inch cold mill.

Kirkpatrick & Co., Ltd., of Pittsburg, operating the Leechburg, (Pa.) Iron Works, manufacturers of fine sheet iron and sheet steel, have lately bought out the business of J. S. Ingalls & Co., of Troy, O. This concern has been making planished steel, but the plant has been removed to Leechburg and some important additions made.

At the wire nail works, New Castle, Pa., a reduction of wages goes into effect with the New Year.

At Oswego, N. Y., the Holbrook building, occupied by the Vulcan iron works and the Oswego bicycle factory, was destroyed by fire, Jan. 1. Loss, $30,000.

At Beaver Falls, Pa., the employes of the American Axe & Tool Co. met to consider the new scale, calling for a reduction in all departments from 14 to 15 per cent, and decided not to accept it.

The H. C. Frick Coke Co. is making a test of beams for use around shaft bottoms in place of timber, as recently illustrated in *The Iron Trade Review*. A trial of them is now being made at Leisenring No. 1 coke plant in the Connellsville region.

On Jan. 1, the Thomas Brass & Iron Co. removed from Milwaukee to their extensive new plant at Waukegan, Ill., where they have completed a machine shop 400x80 feet, a boiler house 144x40, an iron foundry 250x60, and a brass foundry 200x60. In all, the company will occupy seven and a half acres of ground there. The general offices, shipping department, storehouse, etc., will remain in Milwaukee.

The Niles Tool Works, of Hamilton, O., received last month several large orders for a general line of machinery from France, through their agent in Paris.

The Garden City Wire & Spring Co., of Chicago, has recently fitted up its plant with the Thurman Fuel Oil Burner Co.'s system, and will use it in tempering.

THE German iron-makers have not found the treaty, which opened the Russian markets to them, as great a benefit as they expected. The pig iron production has increased, but complaints are made of the depressed state of the trade in finished iron and steel. Prices continue to fall, and many of the smaller works have been compelled to shut down. It is only the larger establishments, those that are able to work at low cost and to adopt the best and most economical methods, which have found themselves in a position to meet the market and continue running. The German manufacturers continue their efforts to build up export trade in the hope of improving matters, and they are meeting with some success, especially in Eastern Europe, where German iron and steel are replacing British to an extent not at all relished by the English ironmasters.—[Engineering and Mining Journal.

CAR wheels are being made at three-quarters of a cent a pound, $4.50 for wheels weighing 600 pounds, and are the cheapest iron castings on record in this country. It seems only a little while ago when car wheels of this weight, or less weight, brought $26 to $30 apiece, and we doubt if any one can make a good car wheel out of proper material for 75 cents per 100 pounds.—[Industry.

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ALL SIZES.
Dwarfs in size and Giants in Strength.
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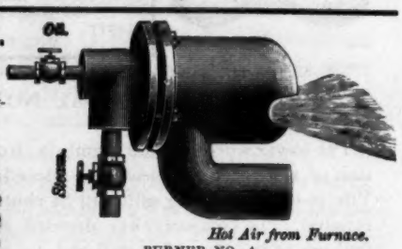

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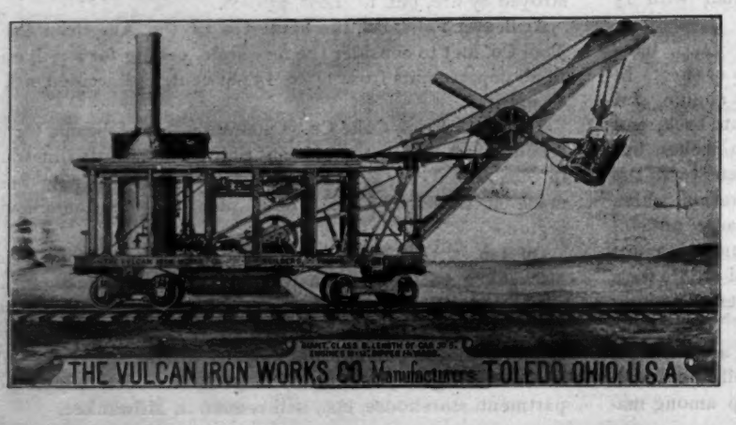
IF the name of your company is not already on the subscription list of *The Iron Trade Review*, would it not be a good idea to put it there? This paper is recognized as representative of the great iron ore, blast furnace, foundry, machine shop, iron and steel works and metal working interests of the Central West and the Northwest—sections that contain the backbone of the buying and producing strength of the country in all forms of iron and steel products. Their advance in the new era of low costs will be rapid, and *The Iron Trade Review* will keep you posted about it.



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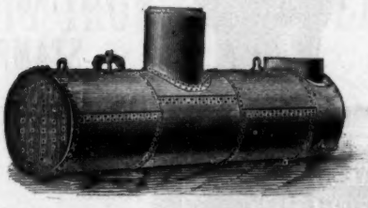

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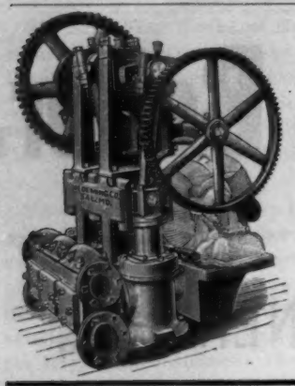

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Once a Year

we take stock and make up a list of our **New Machinery.**

Any machine that has been in our store for over a year is listed at the second-hand prices. Our new machinery must not be shop-worn. It must **look** new as well as **be** new. If it loses its looks you can get it at a reduction

We never list the same machine more than **twice.** The second time, we make the price so low that it sells in a week or two.

Our 94 List is just out. It contains several valuable shop-worn machines; several bargains in shop-worn machinery which is, this year, listed for the **second time.**

One of these is perhaps just the machine you want.

Let us send you a List.

We have a special department for first-class, second-hand machinery. We generally have some special bargains here. They are also mentioned in our List.

HILL, CLARKE & CO.,
Machinery Merchants,
156 OLIVER ST., 12 and 14 N. CANAL ST.,
BOSTON. CHICAGO.

REVOLVING DATING STAMP.

What is it for?

DATING

Checks, Letters, Invoices, Statements, etc.

What will it do?

PRINTS

All the Months, Years from 1894 to 1899, Figures 0 to 99, "Rec'd," "Ans'd," "Paid," "Ac'p'd," "Ent'd."

Will never get out of order.

Price **50 Cents.** SIZE OF TYPE **DEC 25 1899**

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OTIS STEEL

The Otis Steel Co., Limited,

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Steel Firebox Plate,
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Steel Forgings,
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Piston Rods, etc., etc.

Also Steel Castings, any size up to 30 tons.

Branch Offices: NEW YORK, Boreel Building, 115 Broadway. CHICAGO, ILL., 1425 Old Colony Building. ST. LOUIS, MO., 516 North Third Street.

HUMPHREYS, VANDEVORT & CO.,

BROKERS AND DEALERS IN

PIG IRON, STEEL BILLETS AND SLABS, OLD IRON RAILS, ETC.

SPELTER a specialty.

LEWIS BLOCK, PITTSBURG, PA.

Gutta-Percha Roofing!

WIRE EDGE LOCK JOINT.

Light, Cheap, Cool, Durable. Collects No Moisture from Under Side. No Drippings. Resists Acids and Gases Arising from Inside of Foundries, Iron Works, Mills, Etc.

Litho-Carbon Paint for Metal Roofs and Sidings, Bridges, Smokestacks, etc., covers more space than any other paint; dries quick; won't crack, peel or blister; will stand a heat of 550° Fahrenheit. Send for 32-page catalogue.

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Do not **HESITATE.** Avail yourself of this opportunity **"AT ONCE."** Increase your knowledge of your vocation, of nature, and of the political and social questions now in vogue, such as **PROTECTION, FREE TRADE, LABOR, CAPITAL, GOVERNMENT, &c., &c.**

THIS UNPARALLELED OFFER

IS MADE TO ANY PERSON acquainted with the steam-using trade, who can and will influence the patronage of several permanent customers for Lord's Boiler Compound. This task is of *easy accomplishment* to all those who will utilize a portion of their *leisure time* in rendering me this assistance.

PRACTICAL ENGINEERS, owing to their constant contact with the steam-using trade, can especially render me much valuable service, and thus obtain a superior library *free of all expense.*

The preservation of the steam boiler, and the development of its maximum evaporative power and economy, can only be attained by unceasing vigilance and intelligent care; and the toleration of incrustation and corrosive action can only be considered as an **ABUSE** of the most harmful character.

Do Not Start Up an EXPERIMENTAL CHEMICAL LABORATORY IN YOUR STEAM BOILERS.

AVOID ALL BOILER FLUIDS, which are invariably acid preparations, and confine your selection of an incrustation preventative exclusively to such articles as have an established **REPUTATION AND WIDE DEMAND.**

LET PRUDENCE DICTATE THE USE OF LORD'S BOILER COMPOUND.

THE BEST. THE CHEAPEST. THE MOST REPUTABLE.

It is exclusively used by the U. S. and many Foreign Governments; it is favorably mentioned in our best Modern Treatises on Steam Engineering; it is endorsed by our Boiler Insurance Companies; it is cheaper to the consumer; is easier of application, and is of a strictly non-volatile nature; therefore, it will not pass over with the steam. Its sale is equal to the **COMBINED OUTPUT** of the best known preparations on the market.

THE CHEMICAL ACTION OF LORD'S BOILER COMPOUND

Is thoroughly **BASIC** in nature; it is exclusively composed of soluble chemical bases, which decompose and disintegrate boiler scale by appropriating the acids of the scale-forming salts, etc., thus reducing these compound salts into simple rotted oxides, destroying their crystalline character, physical properties, and capacity to solidify. The action is similar to the disintegration of rocky masses, so common to ordinary observers. The surface of the rock is gradually decomposed by atmospheric action, or oxidation, until the rocky mass is converted into a loose, sandy soil, which cannot subsequently solidify. This comparison best describes the action of Lord's Boiler Compounds, and is unquestionably the most competent known to the science of chemistry. Vegetable fluids being chiefly of an acid composition, execute this work by the acid substance attacking the scale, and while frequently efficacious, they are also destructive to the iron. REMEMBER THAT BASIC CHEMICALS are always prepared in a DRY CRYSTALLINE FORM. **NEVER** in the form of a **LIQUID. DO NOT COUNTENANCE LIQUID ARTICLES. FURNISH YOUR OWN WATER,** and demand the dry materials from which liquids are prepared.

The three words, "LORD'S BOILER COMPOUND," are only my Trade Mark, under which I manufacture such different preparations as to meet the requirements of every individual steam user, and to this fact, along with my many years' experience, is due the world-wide reputation of my chemical preparations, known under the head of "LORD'S BOILER COMPOUND."

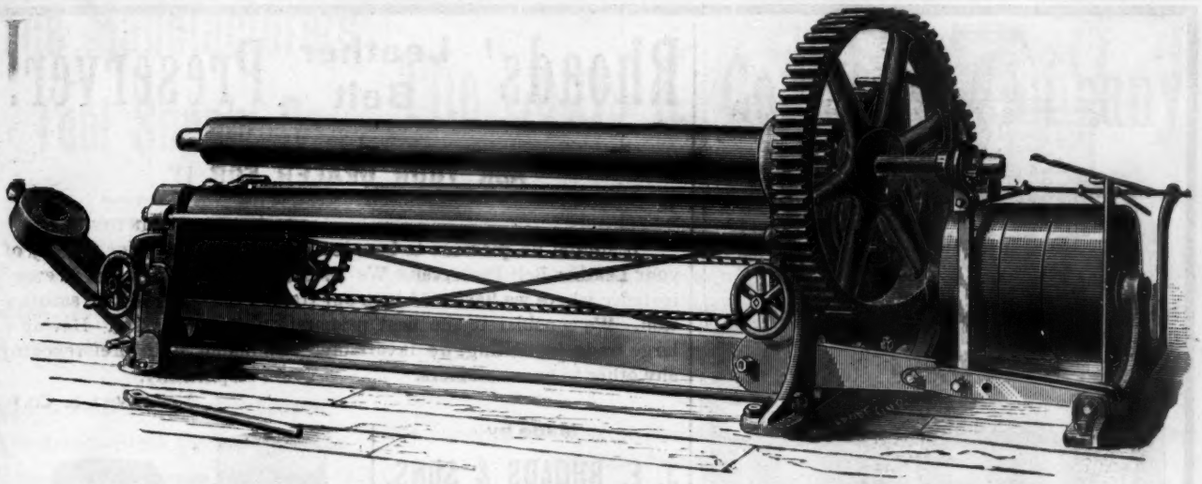
Full particulars, how to make a sure success in using my Compounds, will be given on request.

I furnish many consumers who order from a ton to a carload of the Compound at each order.

All correspondence should be addressed to

GEORGE W. LORD,

316 UNION ST., PHILADELPHIA, PA.



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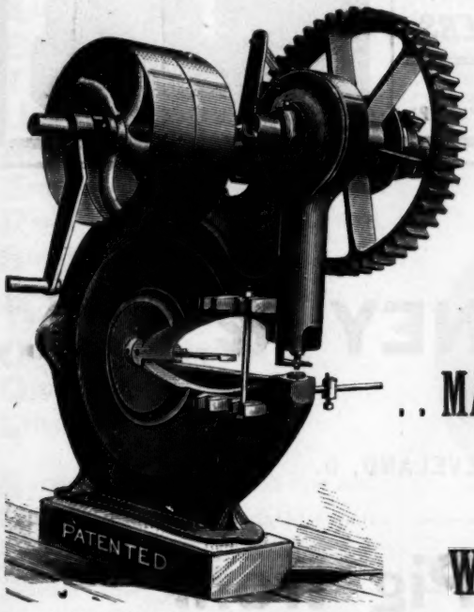
A revolution in rapidity of adjustment and convenience in removing formed metal. Made in any required size up to bending 1 inch plates.



NO. 21, BACK GEARED POWER PUNCH, WITH 15" TO 21" THROAT FOR ¼ THROUGH ¼ AND LIGHTER.

Special sizes made to order.

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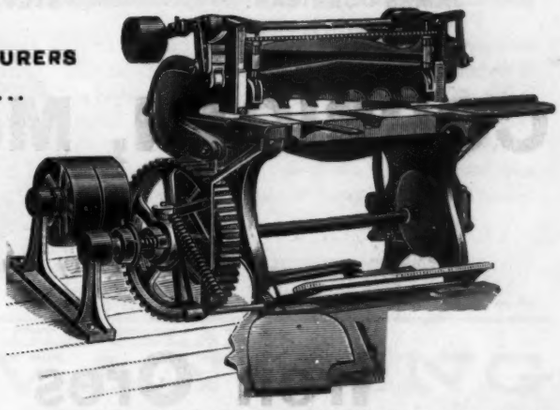

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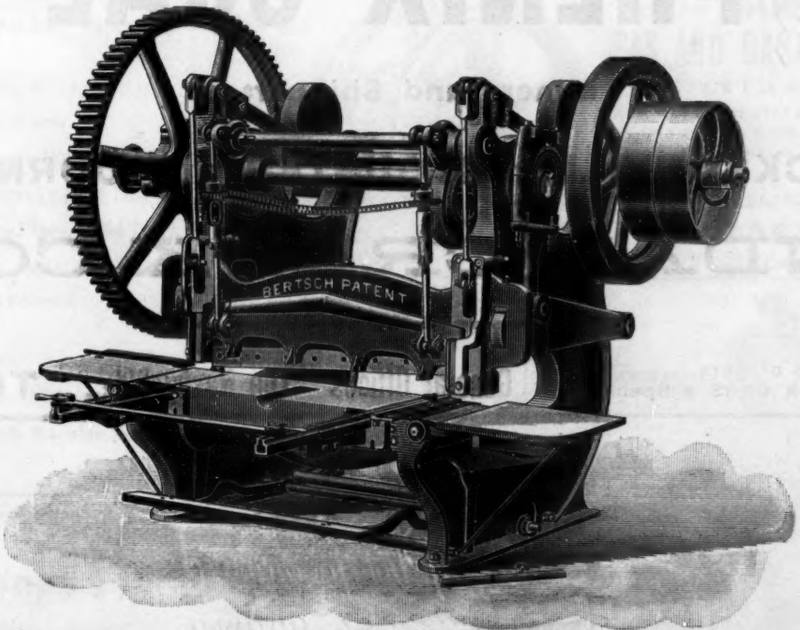
Made in any length to 11 feet, with 6" to 21" throat.



50 INCH POWER CAP SHEAR FOR SQUARING, TRIMMING AND SLITTING 1-4 AND 3-8 PLATES.

For this class of work it is the best, most complete and perfect shear on the market. Made in five sizes with 12 to 24 inch throat.

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5-lb. Can	$ 1.50
10-lb. Can	2.90
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Less 30 per cent. discount. Try a can, and if you do not like it, don't keep it.

Rhoads' Leather Belt Preserver.

ASK YOUR DEALER FOR IT.

STAUNTON, VA.

It affords us pleasure to bear testimony to the superior quality of your Leather Belt Preserver. We have used it ourselves, and in every instance where we have sold it to our trade it has given entire satisfaction. We consider it the best preparation on the market. Having a large trade in belting, we invariably recommend it in preference to any other to our customers. Yours respectfully,

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Made by

J. E. RHOADS & SONS,

BELT MANUFACTURERS,

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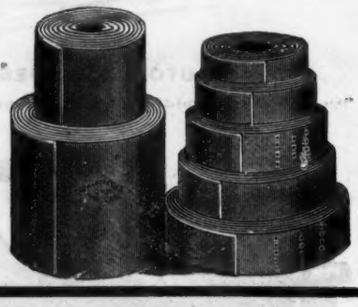

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SUNDAY CREEK COAL.

Owners of Cars.
Shipments in BOX CARS a Specialty.

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Taps, Dies, Pipe and Screw Plates,
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Morse Twist Drill and Wire Gauges,
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Cear, Tap and Reamer Cutters,
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Improved Hand and Bench Vises,
Letters, Figures and Steel Stamps,
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Leland Hotel, Chicago.
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John M. Smyth, (Store) Chicago.
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Residence of Judge Anthony, Evanston, Ill.
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"LUNKENHEIMER'S" Regrinding, Horizontal, Angle and Vertical Check, and Ball Check Valves are acknowledged to be perfect in every respect. Invariably used were the best is wanted. Once used, always used. Nothing so convincing as a trial. Our new Catalogue will post you on superior Valves, Whistles, Lubricators, Oil and Grease Cups. Gratis upon request. **Specify and insist** on "LUNKENHEIMER'S" make. Consult dealer.

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CLEVELAND
GALVANIZING
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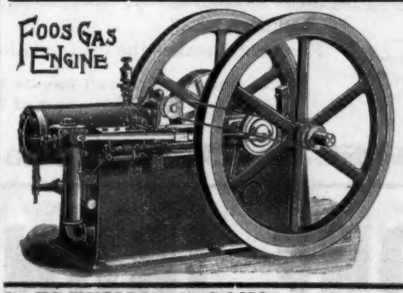
H. H. HODELL & CO.,
Galvanizing in all its branches, and Manufacturers of Rubber Buckets for chain pumps.
CLEVELAND, OHIO.



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GAS AND GASOLINE ENGINES.
FROM 1 TO 50 HORSE POWER.
These Engines give a regular, steady speed Can be run with Manufactured Gas, Natural Gas, and Gasoline.

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FOOS GAS ENGINE CO.
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S. FREEMAN & SONS
MFG. CO.,
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MANUFACTURERS OF
Standard Tubular, Fire Box, Vertical and Submerged Tube Steel
BOILERS
For **Stationary, Portable,** or **Marine use.**
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Smokestacks, etc.,
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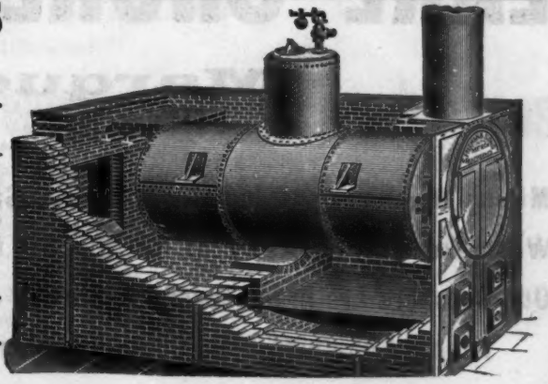
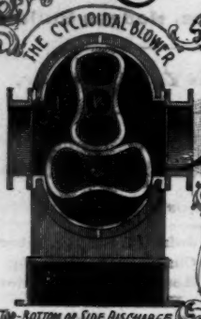
Write for Prices and Terms.



THE CONNERSVILLE BLOWER CO.



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MANUFACTURERS OF

ROTARY-POSITIVE-PRESSURE BLOWERS

FOR ANY PURPOSE REQUIRING AIR OR GAS TO BE HANDLED UNDER PRESSURE

GUARANTEED TO EXCEL IN DESIGN—CONSTRUCTION-OPERATION & EFFICIENCY.

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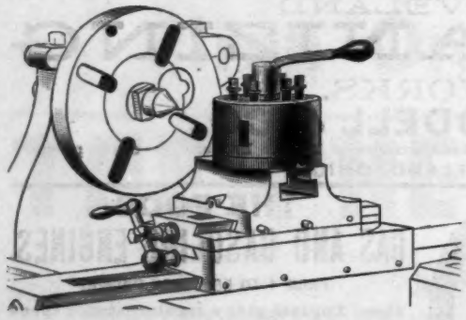

No. 1 Diam. 4¼", tool slots, ½ x 1½, $20.00.
" 1½ " 4¼", " " ⅜ x 1½, $20.00.
" 2 " 6½", " " ⅜ x 1½, $32.00.

EXTRACTS FROM CUSTOMERS' LETTERS:

"Fully up to your recommendation."
"As it takes regular lathe tools, there is no expense in fitting up for ordinary jobs."
"Frequently makes the engine lathe the equal of a screw lathe."

If your dealer don't handle them, we will send C. O. D. prepaid east of Missouri river.

W. H. HOLMES & CO., 226 LaSalle St., CHICAGO, ILL.

LAKE SHORE IRON WORKS,

Marquette, Mich.

MANUFACTURERS OF

Mining Machinery, Quarry Machinery, Saw Mill Machinery, etc.

We make a SPECIALTY of CRUSHERS for the hardest Iron Ores.

Our Crushers are in successful operation at the Mines of the Minnesota Iron Co. at Soudan, Minn., Champion Iron Co., Champion, Mich., Iron Cliffs Co., Ishpeming, Mich.

"LUNKENHEIMER."

WHENEVER and WHEREVER you see above Trade-Mark upon any Brass or Iron Specialty, you may be absolutely certain that it is the VERY BEST article of the kind that money and ingenuity can possibly produce.

Beware of inferior counterfeits and infringements. None genuine without our name.

(THIS MEANS JUST WHAT IT SAYS. OUR GOODS THE PROOF.)

COMPRISE:—Superior "Lunken" Gate Valves; "Regrinding" Globe, Angle and Check Valves; Pop Safety Valves; Lever Throttle Valves; "Handy" Gate Valves; Steam Whistles; "Mocking-Bird" Whistles; Single Bell Chime Whistles; Steam Cocks; Water Gauges; Unions; Sight Feed Lubricators; Oil Pumps; Grease Cups; Glass Oil Cups; Loose Pulley Oilers, Etc. Everything warranted. Our 1895 Catalogue, gratis upon request, will interest you.

SPECIFY and INSIST upon the "Lunkenheimer" Make.
Consult Dealers.

THE LUNKENHEIMER COMPANY,

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Branches: NEW YORK—LONDON.

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BAR IRON. **PIG IRON.**

CHERRY VALLEY IRON WORKS,

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Makers of the Celebrated

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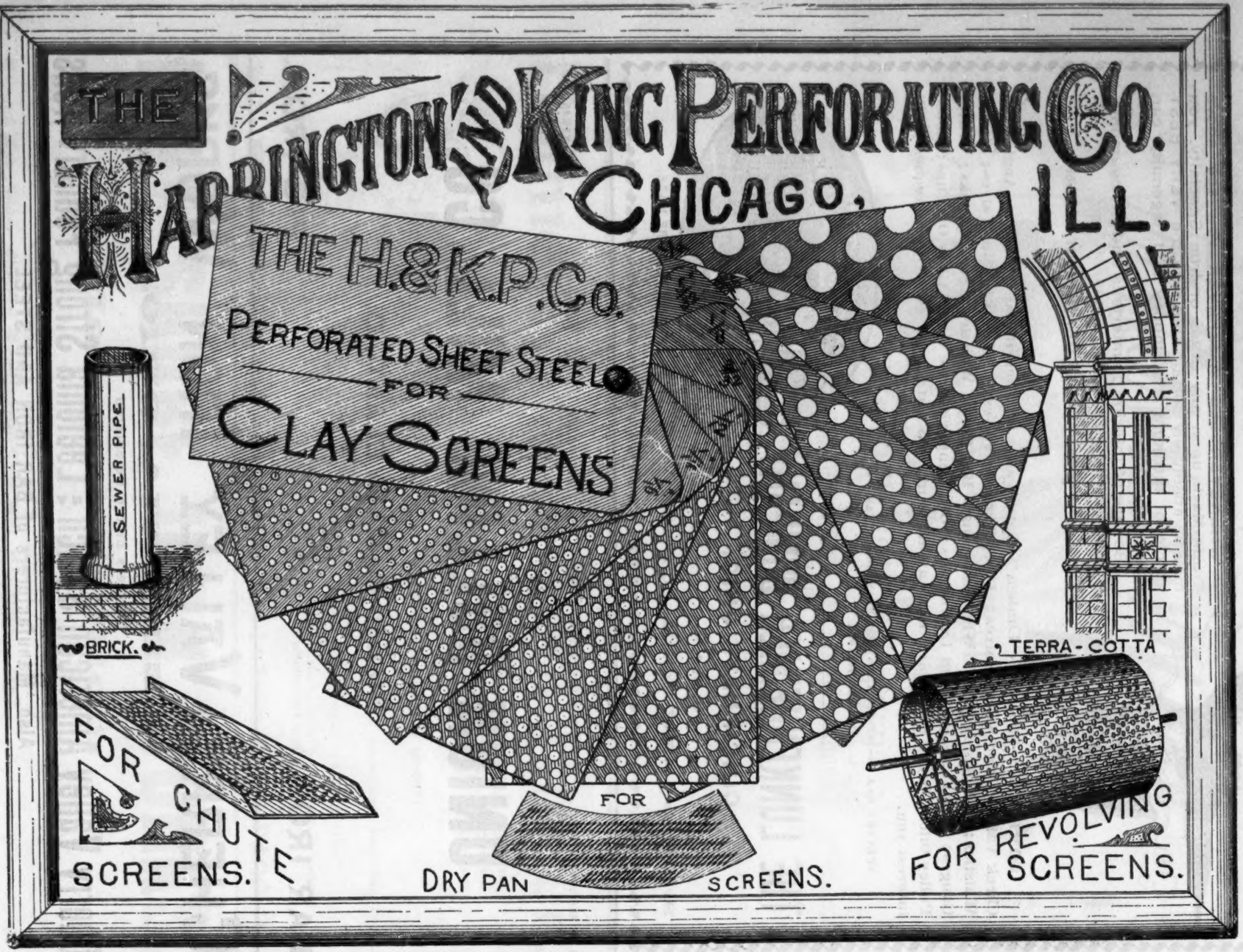
Also, Manufacturers of BAR IRON AND STEEL.

Special attention given to material for Agricultural Implements, small T Rails, Channels, Angles and other Special Shapes.

Manufacturers of Coke and Miners of Washingtonville Coal, both No. 3 and No. 4 Veins, which is highly recommended for Gas, Steam and Domestic purposes.

Consumers of these classes of material are solicited to write for prices before placing orders.



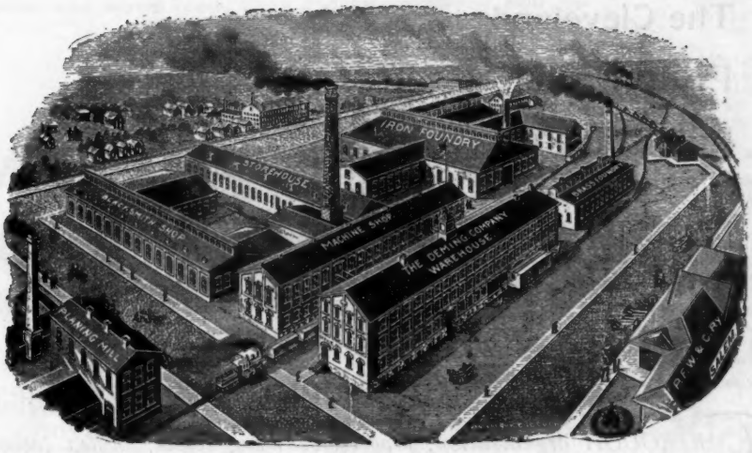
We also wish to call attention to our advertisements on pages 66 and 76.

THE DEMING COMPANY,

SALEM, OHIO,

Manufacturers of

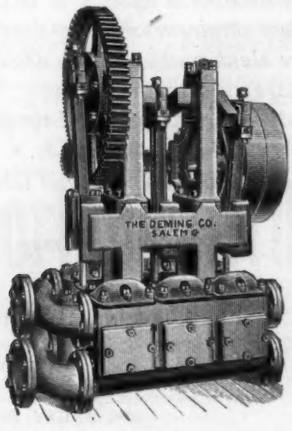
Hand and Power Pumps.



WORKS AT SALEM, OHIO.

General Service Triplex Power Pump

FOR 150 LBS. PRESSURE.



For Boiler Feeding (hot and cold water), Pulp Grinder Feeding, Hydraulic Elevators, Hydraulic Presses, etc.

WRITE FOR CATALOGUE.

A Record and a Secret.

THE RECORD.

FROM a modest plant contained in three rooms, in 1887, to a large, modern building, having five floors, packed with all of the accessories which go to make up a first-class printing establishment—that is the record of

The Cleveland Printing and Publishing Co.

Office and Works: 27, 29 and 31 Vincent St.

THE SECRET.

THOROUGH organization, progressive management, skilled labor, the best of machinery, modern methods, first-class work, and honorable business dealings—to these can be traced the secret of success which has produced

One of the Most Complete Plants in the Central West.

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We print, illustrate and electrotype books.
We design and execute catalogues.
We manufacture blank books of every description.
We print magazines and newspapers.
We produce engravings by all the modern processes.
We rule blanks of all kinds.
We print diplomas and school registers.
We print bonds and stock certificates.
We bind old magazines and all sorts of books.

All of the books turned out by this establishment bear the imprint

The Cleveland Printing and Publishing Co.,

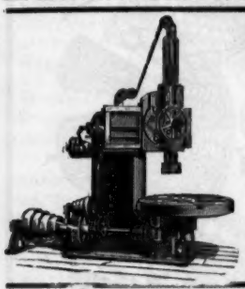
CLEVELAND, O.

W. M. DAY, President.
F. J. STARAL, Vice Pres. & Gen. Mgr.
G. H. GARDNER, Sec'y & Treas.
A. WINTEMBERG, Superintendent.

—FOR—

JESSOP'S STEEL Tools, Drills, Dies, etc.

Established over a Century ago. Manufactory, SHEFFIELD, ENGLAND.
CHIEF AMERICAN OFFICE, 91 JOHN ST., NEW YORK.
WM. JESSOP & SONS, Limited.
"Medal—World's Columbian Exposition, 1893."
All sizes carried in stock by The W. Bingham Co., Cleveland, Ohio.



BORING and TURNING MILLS.

A strictly first-class Tool at a moderate cost.
We want to show you the results our Machines have produced.

BICKFORD DRILL & TOOL CO.,
35 Pine Street,
CINCINNATI, OHIO

Barnes' Upright Drills.

20 TO 42 INCH SWING.

Lever and worm feed, back geared, self feed and automatic stop; with or without sliding head. (3)

COMPLETE LINE HIGH GRADE TOOLS.

W. F. & John Barnes Co.,
191 Ruby St., ROCKFORD, ILL.

A small investment will carry an assortment of our

"SPLIT COLLARS,"

sizes to correspond with the shafting you use. They can be put on without disturbing pulleys or boxes. Write for circular.

THE GOUVERNEUR MACHINE CO.,
GOUVERNEUR, N. Y.

Manufacturers' Tool Supply Co.,

DEALERS IN A FULL LINE OF

MACHINISTS' SUPPLIES.

No. 17 South Canal Street, Chicago.

Morse Twist Drills, Kearney & Foot's Files. Wiley & Russell's Lightning Screw Plates, etc, Billings & Spencer's Wrenches, etc.

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We are the only Steel Roofing Co. awarded Medal and Diploma for **PATENT CAP ROOFING** at World's Columbian Exposition. We are also large manufacturers of all styles of METAL ROOFING, SIDING, CEILING, ETC. Send for Catalogue and Price List. Mention this paper.

SYKES IRON & STEEL ROOFING CO., - Chicago and Niles, O.

Moffet Portable Drill

UNSURPASSED AS A REAMER.

Weighs 48 pounds and drills from ⅜ to 2 inches diameter.

Runs with Steam or Compressed air.
Will Work in Any Position.
An Economical Substitute for Ratchet Drilling
Send for Circular.

MANUFACTURED BY

J. G. TIMOLAT
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Subscribe for the Iron Trade Review, $3 per year.

SECOND-HAND MACHINERY.

9″x4 ft. foot Power engine lathe, screw cutting.
12″x6 ft. screw cutting engine lathe.
13″x5 Putnam plain feed engine lathe, rise and fall carriage.
16x6 Prentiss screw cutting lathe, rise and fall rest with chuck tools, etc. In fine order.
16x6 Pratt & Whitney plain feed lathe, compound rest. In A1 order
18x6 New Haven lathe, screw cutting, rise and fall rest, with chuck.
20″ Wood lathe, complete.
84″x20 ft. Niles lathe, triple geared.
3 speed lathes, 9, 11 and 16 swing.
10″ Pratt & Whitney screw machine.
1″ Prentiss wire feed screw machine.
12″x4 ft. 6 in. Warner & Swasey turret lathe, 1⅛″ hollow spindle.
12″x5 ft. Lodge & Davis plain Fox lathe, chuck and slide rest.
16″ Windsor Fox Monitor with swivel and chasing bar.
10x10x2 Hendey hand planer.
16x6x3 Pease Planer.
32x32x9 ft. Pond planer, two heads.
18″ Pratt & Whitney level drill.
3⅛″ back geared automatic drill.
Forges, chucks, shafting, hangers, pulleys, etc.

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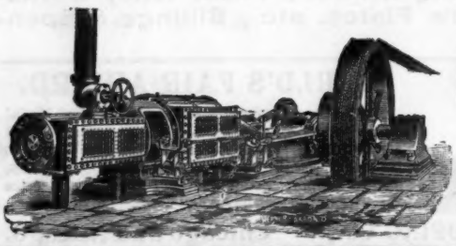

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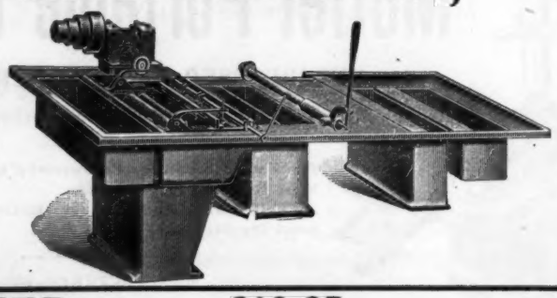

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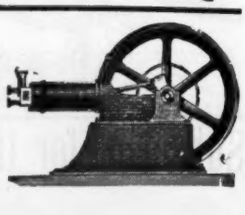

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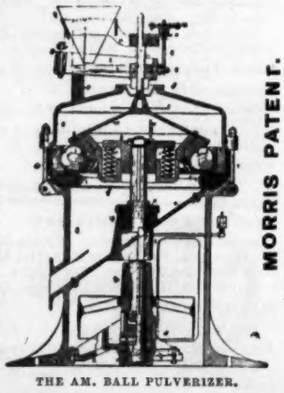
GENTLEMEN: We purchased a No. 2 American Rock Breaker and a No. 2 American Ball Pulverizer from your company about one year ago. The latter part of April, 1893, we started up for regular work, since which time we have run both of said machines to the full extent of our demands and to our entire satisfaction. The first 700 tons of hard iron ore that we pulverized for paint purposes was ground without taking the Pulverizer apart, and without expending one dollar for repairs for either of these machines. Of the 700 tons spoken of, about 200 tons was Lake Superior Specular iron ore, containing some 70 per cent. iron; a very difficult ore to pulverize. The remainder was a red fossiliferous iron ore, carrying quite a per cent. of silex, which cuts out buhr-stones rapidly. We find that the steel balls, which were when new 5 in. in diameter, now caliper 4⅞ in., and are perfectly round and smooth. The grinding track shows very little wear, and the driving track shows LESS; in fact, the wear is almost imperceptible. These two machines crush and pulverize more than one ton per hour with LESS than 12 H. P. We do not know of any Crusher or Pulverizer that can compare with the output of these two machines in quantity, quality, small amount of wear and tear, and like power. In our opinion, you cannot recommend them too highly. Very truly yours,

CLEVELAND IRON ORE PAINT CO.



MORRIS PATENT.

THE AM. BALL PULVERIZER.

LOCATIONS FOR FACTORIES.

The name of the Chicago, Milwaukee & St. Paul Railway has long been indentified with practical measures for the general upbuilding of its territory and the promotion of its commerce, hence manufacturers have an assurance that they will find themselves at home on the company's lines.

The Chicago, Milwaukee & St. Paul Railway Company owns and operates 6,150 miles (9,900 kilometers) of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the lines of the company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota, and North Dakota, possess, in addition to the advantages of raw materials' and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle. Many towns on the line are prepared to treat very favorably with manufacturers who would locate in their vicinity.

Mines of coal, iron, copper, lead and zinc, forests of soft and hard wood, quarries, clays of all kinds, tan-bark, flax and other raw materials exist in its territory in addition to the vast agricultural resources.

A number of new factories have been induced to locate—largely through the instrumentality of this company—at towns on its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway, makes it possible to command all the markets of the United States. The trend of manufacturing is Westward. Nothing should be permitted to delay enterprising manufacturers from investigating. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

Address **LUIS JACKSON,**
Industrial Commissioner, C., M. & St. P. R'y.,
160 Adams St., CHICAGO, ILL.

JOHN ADT & SON,

NEW HAVEN, CONN.

Builders of Machinery for Hardware Manufacture.

AUTOMATIC

Wire Straightening and Cutting Machines,

BUTT MILLING MACHINERY,

Butt Drilling Machinery, Riveting Machines,

Foot Presses, Sprue Cutters, Etc.

GASOLINE ENGINES

Stationary & Portable

ALL SIZES.

Dwarfs in size and Giants in Strength.

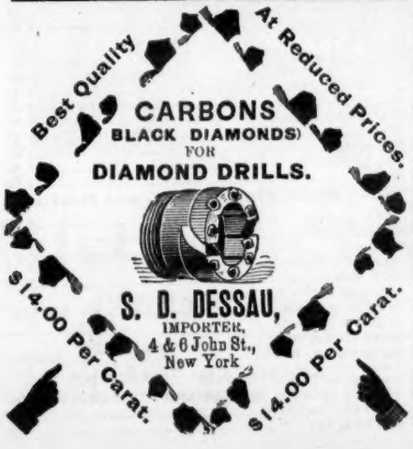
Costs only 10 cents a Day per H. P. to run them, & scarcely any attention.

EVERY ENGINE GUARANTEED

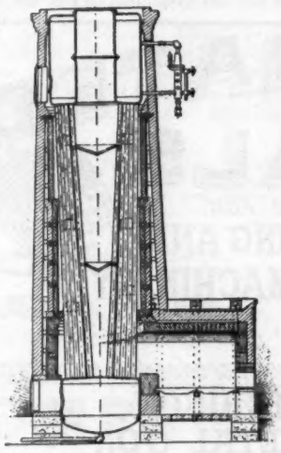
Write for particulars and testimonials.

THE VANDUZEN GAS & GASOLINE ENGINE CO
CINCINNATI, O.

Mention this paper when you write.



"CAHALL"



VERTICAL WATER TUBE BOILER

Best in the World.

MANUFACTURED BY

The AULTMAN & TAYLOR MACHINERY CO.

Mansfield, Ohio.

Highest Efficiency, Lowest Price.

Leads all makes of boilers in economy, capacity, ease of examination, cleaning and repairs. Send for description, tests, references and estimate before you purchase.

H. E. COLLINS & CO.,

Sole Sales Agents for the United States.

Bank of Commerce Bldg., PITTSBURG, PA.
933 Rookery, CHICAGO, ILL.

Any of our subscribers or advertisers who wish to keep the copies of *The Iron Trade Review* and who will send us 75c in stamps or postal note, will receive postpaid, a substantial, handsome binder as shown in above cut. Address

THE IRON TRADE REVIEW,

27 Vincent Street, Cleveland, Ohio,
OR
1141 Monadnock Blk., Chicago, Ill.

Room 508,
Cuyahoga Building, **Cleveland, Ohio.**

Jopling & Escobar,

ENGINEERS.

Mining Reports and Estimates. **Spanish-American Business a Specialty.**

IRON AND STEEL MARKETS.

IRON ORE.

[On Lake Erie docks.]

No. 1 Specular, Bessemer	3.00@ 3.35
No. 1 Bessemer hematite	2.75@ 3.00
Hematites No. 1 non-Bessemer	2.00@ 2.50
No 1. Specular, non-Bessemer	2.35@ 3.00

PIG IRON.

CLEVELAND (f. o. b. cars):	
Bessemer	$10 65@$00 00
No. 1 Strong Foundry	11 25@ 11 65
No. 2 Strong Foundry	10 25@ 10 65
No. 1 Gray Forge, red short	9 50@ 9 75
No. 2 Gray Forge, neutral	9 25@ 00 00
No. 1 American Scotch	11 65@ 00 00
No. 2 American Scotch	10 65@ 00 00
Lake Superior Charcoal	13 00@ 13 50
PITTSBURG:	
No. 1 Foundry	$11 25@$11 75
No 2 Foundry	10 25@ 10 75
Gray Forge	9 50@ 9 75
White and Mottled	9 00@ 9 25
Warm Blast Charcoal	18 00@ 19 00
Cold Blast Charcoal	25 00@ 26 00
Bessemer	10 65@ 00 00
CHICAGO (reported by our representative):	
Lake Superior Charcoal	$13 00@$14 50
Local Coke Foundry No. 1	10 25@ 10 50
Local Coke Foundry No. 2	9 75@ 10 00
Local Coke Foundry No. 3	9 40@ 9 65
Local Scotch Foundry No. 1	10 25@ 10 50
Local Scotch Foundry No. 2	9 75@ 10 00
Local Scotch Foundry No. 3	9 50@ 9 75
Southern Coke No. 1	11 00@ 11 25
Southern Coke No. 2	10 25@ 10 50
Southern Coke No. 3	10 00@ 10 25
Southern No. 1 Soft	10 25@ 10 50
Southern No. 2 Soft	10 00@ 10 25
Southern Silveries No. 1	11 50@ 11 75
Southern Silveries No. 2	11 25@ 11 50
Jackson Co Silveries	15 00@ 16 00
Ohio Silveries No. 1	14 00@ 14 50
Ohio Silveries No. 2	13 00@ 13 50
Ohio Strong Softeners	13 00@ 13 50
Alabama Car Wheel	17 50@ 18 00
Malleable Bessemer	10 50@ 11 25
Coke Bessemer	11 25@ 11 50
CINCINNATI (reported by Rogers, Brown & Co.)	
Southern Coke No. 1, Foundry	$ 9 75@$10 00
Southern Coke No. 2 and No 1 Soft	9 25@ 9 50
Hanging Rock Coke, No 1	12 00@ 12 50
Hanging Rock Charcoal No. 1. Fdy	16 00@ 17 00
Tennessee Charcoal No 1	14 00@ 14 50
Jackson County Stone Coal No 1	14 50@ 15 00
Southern Coke, Grey Forge	8 50@ 8 75
" " Mottled	8 25@ 8 50
Standard Alabama Car Wheel	15 75@ 16 75
Tennessee " "	15 50@ 16 00
Lake Superior " "	14 00@ 14 50
BUFFALO (reported by Rogers Brown & Co.)	
No. 1 Foundry Strong Coke Iron Lake Superior Ore	$11 75
No. 2 Foundry Strong Coke Iron Lake Superior Ore	11 25
Ohio Softener No. 1	12 25
Jackson Co. Silvery No. 1	15 75@ 16 75
Lake Superior Charcoal	13 50
Southern Soft No 1	11 50
Hanging Rock Charcoal	18 50
ST. LOUIS (reported by Rogers, Brown & Mercham):	
Southern Coke No 1	$10 75@$11 25
Southern Coke No. 2	10 00@ 10 25
Southern Coke No. 3	9 75@ 10 00
Southern Gray Forge	9 50@ 9 75
Southern Charcoal No. 1	14 00@ 14 50
Missouri Charcoal No. 1	12 50@ 13 00
Ohio Softeners	14 00@ 14 50
Lake Superior	15 50@ 16 00
Southern	16 75@ 17 00
Connellsville Coke, St Louis	4 50

OLD RAILS AND SCRAP METAL.

[Prices paid by mills.]

	Gross Tons
Old iron rails	$12 50
Old steel rails	10 00
	Net Tons
No. 1 R. R. wrought scrap	$ 9 50
No. 1 wrought scrap	8 50
No. 1 Machine cast scrap	8 50
Iron axles	15 50
Axle turnings	8 00
Wrought turnings (free from cast)	6 50
Cast borings	5 50
Uncut wrought iron boilers	4 00
Steel boiler plates	8 00
Grate bars	5 50
Pipes and flues (clean)	7 00
Tank iron	6 75
Hoop and band iron	6 00
Sheet iron	5 00
Wrought drillings	6 50
Malleable iron	7 00

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. mill)	1.25c@1.35c
Angles	1.20c@1.25c
Tees	1.35c@1.45c
Universal Plates	1.20c
Sheared Plates	1.30c

MERCHANT IRON AND STEEL.

[List prices out of store.]

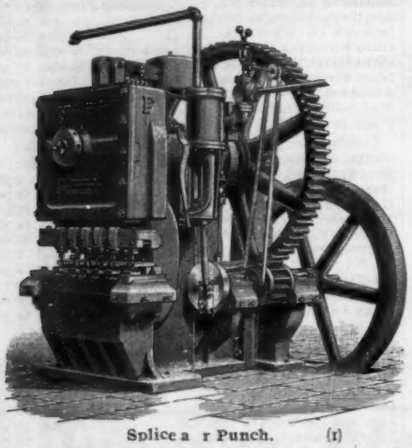
Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 30
4½ to 6 by ⅜ to 1 inch	1 35
1¾ to 6 by 1⅛ to 2 inch	1 50
1¼ & 1⅜ by ⅜ to ¾ inch	1 35
1 & 1⅛ by ⅜ to ¾ inch	1 40
⅝, ¾, ⅞, by ⅜ to ⅝ inch	1 50

Frank P. Cady, Pres. and Supt.
Geo. H. Bowler, Sec'y and Treas.
THE CADY MFG. CO.
283 W. River St., CLEVELAND, O.

AUTOMATIC MACHINERY.
Power Presses, Dies, Drop Hammers, Punches and Shears, Wire Straighteners and Cutters, Wire Forming Machines
SEND FOR CATALOGUE.

PERFORATED METALS
OF ALL KINDS FOR
MILLING MINING AND AGRICULTURAL MACHINERY,
PERFORATED IRON, STEEL, COPPER, BRASS, TIN, ZINC, LEAD, ETC., TO ORDER.
LARGE AND VARIED ASSORTMENT OF SIZES. CORRESPONDENCE SOLICITED.
THE ROBERT AITCHISON. PERFORATED METAL CO.,
OFFICE, ROOM 510 265 TO 269 DEARBORN STREET, CHICAGO, ILL. WORKS SOUTH CHICAGO.


Splice a r Punch. (1)

—THE—
Long & Allstatter Co.
HAMILTON, O., U. S. A.
Manufacturers of Belt, Steam and Electrically driven
POWER PUNCHES and SHEARS,
for all kinds of Boiler, Tank and Structural Iron Work, Rolling Mills, Locomotive Shops, Car and Wagon Shops, Plow Shops, etc. Send for Catalogue.

A. H. LEITCH, PRES JOHN C. LEITCH, SEC. AND GENL. MAN. JOHN A. WILSON, TREAS.
WESTMORELAND FIRE BRICK CO.
MANUFACTURERS OF HIGH GRADE FIRE BRICKS
PITTSBURG, PA.
Works and Mines, Westmoreland, Pa.

DIXON'S GRAPHITE PAINT
FOR TIN OR SHINGLE ROOFS AND IRON WORK. IT IS ABSOLUTELY WITHOUT AN EQUAL.
Tin roofs well painted have not required repainting for 10 to 15 years.
If you need any paint it will pay you to send for circular.
JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.

IRON CLAD PAINT CO.
Factory, 75 & 77 Central Way. Sec. & Treas., No. 3 Case Build'g,
CLEVELAND, OHIO.

Trade Mark Pending.
ORDER DIRECT FROM THE
Iron Clad Paint Co.
And get the genuine article, and save liability of suit for using an article made in violation of the patents issued to Wm. Green, and now owned by this Company.
IRON CLAD PAINT is the most durable, most fire-proof and Cheapest Paint made.
FURNISHED both Dry and Ground in Oil
USED BY NEARLY ALL THE RAILROADS.

Round and Square.

1 to 1⅜ inch	1 30
2 to 2⅜ inch	1 40
2¾ to 3¾ inch	1 55
3⅜ to 4 inch	1 80
4¼ to 4½ inch	2 40
4¾ to 5 inch	2 60

Oval.

⅞ to 1¼ inch	1 50
⅜ to ¾ inch	1 50
½	1 70
⅜	1 90

Half Oval and Half Round.

1½ to 3 inch	1 85
⅞ to 1½ inch	1 65
⅜ to ¾ inch	1 90
½	2 05
⅜	3 15

Heavy Band.

1¼ to 6 by ¼ and 5-16 inch	1 40
1 to 1⅜ by ¼ and 5-16 inch	1 45
¾ to ⅞ by ¼ and 5-16 inch	1 55
⅛ to ⅜ by ¼ and 5-16 inch	1 80

Hoop Iron.

1 7-16 to 4, No. 13, 14, 15 and 16	1 85
1 7-16 to 2, No. 17, 18 and 19	1 90
1 7-16 to 2, No. 20	2 00
1 7-16 to 2, No. 21	2 10
1 7-16 to 2, No. 22	2 20
1⅛ to 1⅜, No. 13, 14 and 15	1 90
1⅛ to 1⅜, No. 16, 17 and 18	1 95
1⅛ to 1⅜, No 19 and 20	2 00
1⅛ to 1⅜, No. 21	2 10
1⅛ to 1⅜, No. 22	2 20
15-16 and 1 inch, No. 13, 14 and 15	1 85
15-16 and 1 inch, No. 16, 17 and 18	2 00
15-16 and 1 inch, No. 19 and 20	2 10
15-16 and 1 inch, No. 21	2 20
15-16 and 1 inch, No. 22	2 30
⅞, No. 13, 14 and 15	2 10
⅞, No. 16. 17 and 18	2 20
⅞, No. 19 and 20	2 30
⅞, No. 21	2 40
⅞, No. 22	2 50
13-16, No. 13, 14 and 15	2 20
13-16, No. 16, 17 and 18	2 30
13-16, No. 19 and 20	2 40
13-16. No. 21	2 50
13-16, No. 22	2 60
¾, No. 13, 14 and 15	2 30
¾, No. 16, 17 and 18	2 45
¾, No. 19 and 20	2 55
¾, No. 21	2 65
¾, No. 22	2 75
11-16, No. 13, 14 and 15	2 55
11-16, No. 16, 17 and 18	2 60
11-16, No. 19 and 20	2 70
11-16, No. 21	2 80
11-16, No. 22	2 90
11-16, No. 23	3 00
⅝, No. 13, 14and 15	2 60
⅝, No. 16, 17 and 18	2 70
⅝, No. 19 and 20	2 80
⅝, No. 21	2 90
⅝, No. 22	3 00
⅝, No. 23	3 10
9-16, No. 13, 14 and 15	2 80
9-16, No. 16, 17 and 18	2 90
9-16, No. and 20	3 00
9-16, No. 21	3 10
9-16, No. 22	3 20
9-16, No. 23	3 30
7-16 and ½ inch, No. 13, 14 and 15	3 00
7-16 and ½ inch, No. 16, 17 and 18	3 10
7-16 and ½ inch, No. 19 and 20	3 20
7-16 and ½ inch, No. 21	3 30
7-16 and ½ inch, No. 22	3 40
7-16 and ½ inch, No. 23	3 50
⅜, No. 13, 14 and 15	3 50
⅜, No. 16, 17 and 18	3 60
⅜, No. 19 and 20	3 70
⅜, No. 21	4 00
⅜, No. 22	4 10
⅜, No. 23	4 25

Light Band.

1½ to 6 by ⅛ to 3-16 inch	1 60
1½ to 6 by Nos. 11 and 12	1 65
1 to 1⅜ by ⅛ to 3-16 inch	1 65
1 to 1⅜ by Nos. 11 and 12	1 70
⅞ and 13-16 by ⅛ to 3-16 inch	1 80
⅞ and 13-16 by Nos. 11 and 12	1 85
¾ and 11-16 by ⅛ to 3-16 inch	1 90
¾ and 11-16 by Nos. 11 and 12	1 95
⅝ and 9-16 by ⅛ to 3-16 inch	2 05
⅝ and 9-16 by Nos. 11 and 12	2 10
½ by ⅛ to 3-16 inch	2 20
½ by Nos. 11 and 12	2 25

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	1 80
⅞ inch, " " " " 13 and 14	1 90
¾ inch, " " " " 11 and 12	1 95
¾ inch, " " " " 13 and 14	2 15

Sheet Iron.

No. 10	1 85
No. 12	1 90
No. 14	1 95
No. 15-17	2 05
No. 18	2 20
No. 20	2 30
No. 22-24	2 40
No. 25 26	2 50
No. 27	2 60

Steel Boiler Plates—1-4 in. and Heavier.

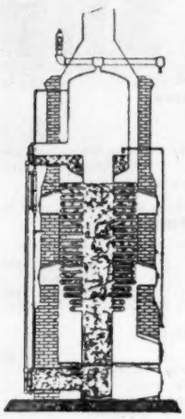
Tank	1 60
Shell	1 85
Flange	2 10
Marine Flange	2 35
Fire Box	3 35

Above includes plates 90 inches wide.

90 to 96 in. wide	½c. lb. extra
96 to 100 in. wide	1 c. "
100 to 104 in. wide	1½c. "
104 to 106 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. lbs
1 to 2 in, inclusive	08
9-16 to ⅞ in. "	08½



THE ADAMS
WATER TUBE BOILER.

This Boiler is absolutely safe from explosion. Gives as much steam from the waste heat as any boiler made. Easy of access for cleaning and repairs. Furnishes perfectly dry steam. Occupies little ground space. Economical in first cost. Send for complete circulars giving list of users and testimonials, one of which is printed below.

The Falcon Tin Plate & Sheet Co., }
NILES, O., Aug. 18, 1893. }

Chas. P. Adams, Esq.

Dear Sir: The three boilers of 225 H. P. each which you furnished us are working in every way satisfactory. We consider them as good steamers as any we have ever used. Up to the present time have spent nothing on them for repairs. Very respectfully,

THE FALCON TIN PLATE & SHEET CO.,
By Warner Arms, Pres't.

C. P. ADAMS,
807 The Cuyahoga, - CLEVELAND. O.

C. W. HUNT COMPANY,

THE HUNT TIP CAR.

45 Broadway, New York,

MANUFACTURERS OF

HOISTING AND CONVEYING MACHINERY

For moving all kinds of material in Steam Power Stations, Factories, Gas Works. Mines, Coal Yards, etc.

Tip Cars, Wire Rope, Barrows.
INDUSTRIAL RAILWAYS.

CLEVELAND ROLLING MILL CO.,

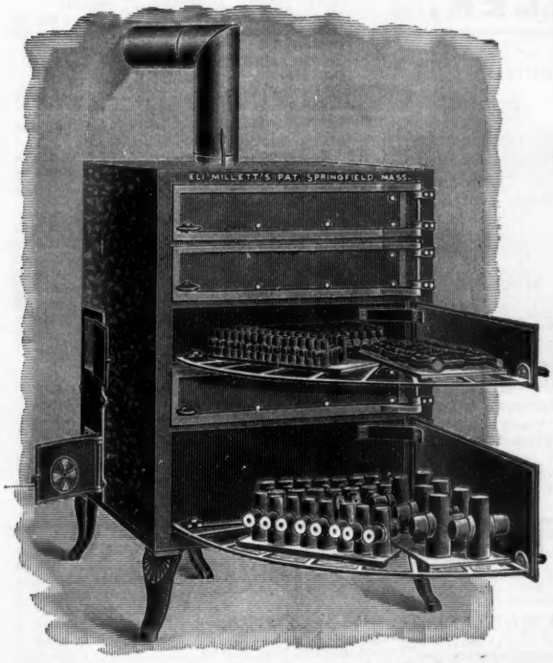
CLEVELAND, - OHIO,

—MANUFACTURERS OF—

BESSEMER AND OPEN-HEARTH STEEL,

Blooms, Billets, and Slabs, Steel Rails, Steel Beams, Channels and Angles. Steel Forgings, Bar Spring, and Sleigh Shoe Steel. Steel Wire of all kinds. Barbed Wire, Iron and Steel Plates, Galvanized and Black Sheet Iron and Steel Corrugated Iron Roofing.

MILLETT'S PATENT PORTABLE CORE OVEN.



THE BEST CORE OVEN On the Market.

Saves Fuel,
" Expense,
" Time.

Does More Work and Makes Better Cores.

If you make small cores you need it.

Write us for Circulars and Prices.

MILLTET CORE OVEN CO.,

Brightwood, (Springfield) Mass.

Bolt and Nut Works.

THE UPSON NUT CO., Manufacturers of Nuts, Washers, Carriage, Machine, Plow and Elevator Bolts, Coach Screws, etc.

Steel Stamps and Stencils.

FLEHARTY, J. H. & Co., Rubber Stamps Seals, Stencils, Automatic Check Punches, and Numbering Machines. 92 Seneca St.

7-16 to ⅜ and 2⅜ to 3 in.	.09
3¼ to 4 in.	.09½
⅜ to 11-16 and 4½	.10
½ to 6 in.	.10½
¼ to 9-32 and 6¼ to 7 in.	.11
3-16 in	.13

Flats.

	cts. lbs.
2 to 9-16 in. wide by 2 to ⅜ thick	.8

Bessemer and O. H. Steel.

Machinery	base price,	1 80
Tire	"	1 85
Spring	"	2 20
Sleigh Shoe	"	2 20
Toe Calk	"	2 05
Cutter Shoes, tapered and bent	"	2 45

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	3 70
Bridge ½, ⅝, 11-16 and ¾ inch diam	3 40

MACHINERY SUPPLY MARKET.

Anvils.

American	₩ lb 9@10
Wright's	₩ lb 12

Bellows.

Blacksmiths'	Hill's	dis 40
	Bullock's	dis 50&10
Moulders'		dis 40@40&10
Hand		dis 40&10@50

Belting.

Boston Belting Co.'s standard	dis 70
" " " extra	dis 60&5
" " " best	dis 55
Cleveland Rubber Co. extra standard	dis 60&10
Hoyt's Short Lap	dis 45
Shultz Raw Hide Leather Belting, single,	dis 40
Munson's Short Lap Single Leather	dis 50
Munson's Short Lap Double and Light Double Leather	dis 50&10
Shultz Raw Hide Leather Belting, Double and Light Double	dis 40
Standard, oak tanned	dis 50&10
Alexander Brothers' pure oak tanned	dis 45

Blowers and Exhausters.

B. F. Sturtevant's	dis 20
Boston Blower Co.,	dis 35
Buffalo	dis 40

Chucks.

Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 30
" 2 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis 35
Horton's Universal	dis40
" Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 40
Sweetland "	dis 40
Almond Drill	dis 20
Morse "	dis 15
Skinner's Combination Lathe	dis 40&10
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 20

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
Standard	dis 10@15
Morse	dis 15
Brown & Sharpe, Milling Cutters	dis 15
" " Gear Cutters	dis 15

Crowbars.

Cast Steel	₩ 3½
Iron, steel points	₩ lb 3

Drill and Drill Sockets.

Twist Drills	dis 50&10
Morse Taper and Straight Shank to 1½"	dis 50&10
Morse Taper and Straight Shank Larger than 1½"	dis 25
Drill Sockets	dis 25
Standard Twist Drills	dis 55@55&5
Cleveland " "	dis 55@55&5

Emery.

	No. 4 to No. 54 to Flour, C. F		
	46 gr.	150 gr.	F. FF.
Kegs, ₩ lb	4½c	5 c	2½c
½ kegs ₩ lb	4¾c	5¼c	2¾c
¼ kegs ₩ lb	5 c	5½c	3 c
10 lb cans, 10 in case	6 c	6½c	5 c
10 lb cans less than 10	10 c	10 c	7½c

Emery Cloth and Paper.

Barder, Adamson & Co.	dis 50@50&5
H. H. Barton	dis 50@50&5

Emery Wheels.

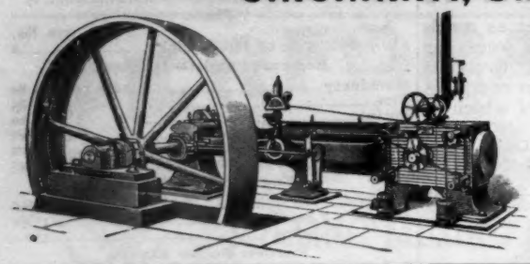
Detroit	dis 60@70
Norton's	dis 60@70
Grant	dis 60@70
Sterling	dis 60@70
Celluloid	dis 10&33⅓
Northampton	dis 55
Crystal	dis 65@70
Vitrified	dis 60@70
Vulcanite	dis 60&10
Hamden	dis 60&10@70
Cyclone	dis 60@60&10

Files.

Arcade	dis 60&10@60&10&10
Nicholson	dis 60&10@60&10&10
" X. F.	dis 25
Kearney & Foot	dis 60&10@60&10&10
Black Diamond	dis 60&10@60&10&10
McClellan	dis 60&10@60&10&10
Disston's	dis 65@70

THE LANE & BODLEY CO.,

CINCINNATI, OHIO.



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THROUGH TRAINS RUN AS FOLLOWS BY CENTRAL TIME
* Daily. † Daily, except Sunday.

FROM CLEVELAND TO	LEAVE	ARRIVE
Pittsburgh and Bellaire	† 7:00 am	†12:10 pm
Salem and Pittsburg	* 8:00 am	* 8:30 pm
Pittsburgh, Bellaire and East	†12:45 pm	† 6:25 pm
Philadelphia and New York	* 1:40 pm	*11:25 am
Baltimore and Washington	* 1:40 pm	*11:25 am
Alliance and Pittsburgh	* 1:40 pm	*11:25 am
Ravenna and Alliance	† 3:25 pm	† 9:50 am
Hudson and Ravenna	* 5:00 pm	* 8:25 am
Philadelphia and New York	*11:10 pm	* 5:25 am
Baltimore and Washington	*11:10 pm	* 5:25 am
Alliance and Pittsburgh	*11:10 pm	* 5:25 am

Mt. Vernon and Pan-Handle Route

FROM CLEVELAND TO	LEAVE	ARRIVE
Xenia and Cincinnati	* 8:40 am	* 5:15 pm
Akron and Columbus	* 8:40 am	*5:15 pm
Akron, Columbus & Zanesville	†2:45 pm	*12:10 pm
Akron and Orrville	† 3:25 pm	† 9.50 am
Columbus and Cincinnati	* 8:00 pm	* 6:55 am

Saturdays the 8:00 pm train will leave at 11:20 pm.

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Depot foot of So. Water St
City Office 137 Superior St.

	Arrive.	Depart
Akron & Canton	*6:30 P M	*7:10 A M
Akron, Canton & Valley Jctn.	*10:10 A M	*3:15 P M
Valley Jctn. & Way Stations	†6:30 P M	†7:10 A M
Akron, Canton & Chicago	*6:00 A M	*6:30 P M
Wooster and Chicago	†2:45 P M	†11:00 A M
Wooster		*6:30 P M
Akron, Canton & Marietta	†2:45 P M	†11:00 A M
Steubenville, Wheeling, Washington, D. C., and Baltimore	†2:45 P M	†11:00 A M

†Daily except Sunday. *Daily. Pullman's Palace Vestibule Drawing Room cars between Cleveland and Chicago.

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WATER TUBE

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will introduce into a limited number of foundries their process for making

SEMI-STEEL. SEMI-STEEL

is a metal of great density and high tensile strength, from 32,000 to 42,000 pounds, and is a good substitute in many cases for steel castings.

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58 FRANKFORT ST CLEVELAND

Western	dis 70
Stub's	dis 25
Grobet's	dis 30
Reynolds Bros.' Hand Cut	dis 50
Industry File Works Hand Cut	dis 50

Hammers.

P. S. W	dis 40
Atha new list, Jan. 15, 1887	dis 50
Heavy hammers and sledges under 5 lbs	12c
" " " over 5 lbs	10c

Jack Screws.

Illinois Bolt Co. list	dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¼	4	3¾	3½
Hexagon	15½	11½	8½	6	5¾	5¼	
Washers	9	8	7	5	4½	4½	4½

In lots less than 100 lbs, ℔ lb add ½c., 1 lb boxes add 1c to list.

Nails (wire).

List July 14, 1887	dis 85
Standard Penny Nails, ℔ keg card rate	
{ Car lots	$1.10
{ Less than car lots	$1.25

Oilers.

Zinc and Tin	dis 60
Brass and Copper	dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ℔ doz	dis 10@10&10

Packing, Steam.

Boston Belting Co	dis 60
American Packing Hemp	℔ lb 9@10
Russia " "	℔ lb 14
Italian " "	℔ lb 13@19
Plumbago Piston	℔ lb 40
Peerless	℔ lb 60
Morrison's "	℔ lb 45
Square Flax "	℔ lb 50
Sheet Rubber	℔ lb 12&24
Excelsior Rubber	℔ lb 48
Rainbow { Full Rolls	45c ℔ lb
Rainbow { Less than Full Rolls	50c ℔ lb
Eclipse Gasket	℔ lb 75

Picks.

Railroads, 5 to 6 lbs	$12 dis 60
" 6 to 7 lbs	$13 dis 60

Pulleys.

Iron Pulleys, Walker List	dis 50
Medart Pulleys	dis 50
Split Wood Pulleys	dis 55@60

Rivets.

Iron, Thousand, list November 17, 1887	dis 50&10@60
Iron, Ordinary, Cooper's Block and Carriage list November 17, 1887	dis 50&10@60
Copper	dis 50@50&10

Saws.

Disston's Circular	dis 40&10
" Band	dis 25
" Scroll	Net
Hack Saw Stubs	dis 20
" " Eureka	dis 20
" " Star	dis 20
Saw Swages Diston's	dis 30
Atkins' Circular Saws	dis 40&45
" Mill, Mulay and Drag Saws	dis 40&10
" Wood Saws	dis 40&10
" Silver Steel Diamond Cross-cut Saws	70c per ft
" Dexter Cross-cuts	50c "
" Diamond "	30c "
" Tuttle Tooth Cross-cuts	25c "
" One-man Cross-cuts	32c "
No. 1 Handles	23c per pair
No. 6 "	16c "
Excelsior Saw Tools	$6 per doz
Derfection "	$15 "
Petroit Saw Works, Circular	dis 50
" " " Band	dis 25
" " " Mulay	dis 45

Taps.

Cards, Hand and Nut to 2 in	dis 50
Carpenters' " " "	dis 50
Morse " " "	dis 50
Pratt & Whitney " " new list	dis 10
Machine Screw Taps	dis 55
Pipe Taps to 2½ in	dis 70
Stay Bolt Taps	dis 25
Stove Bolt Taps	dis 55
Pulley Taps	dis 40

Vises.

Solid Box	dis 60
Parker's	dis 20@25
Prentiss	dis 20
Stephen's	dis 25@30
Barrett's	dis 30
Miller's Falls	dis 40
Merrill's	dis 15@20
Howard	dis 35

Wire.

New List, Apr. 9, 1894

Brass	dis 40
Copper	dis 40
Bright and annealed, Nos. 0@18	dis 70&10@75
" " Nos. 19@26	dis 75@75& 5
" " Nos. 27@36	dis 75&10& 5
Coppered Nos. 0 to 18, market list	dis 70@70& 5
Galvanized Nos. 0 to 18 " "	dis65& 5
Tinned market Nos. 0 to 18	dis 67½
Cast steel	dis 50
Tinned Broom Wire	dis 70&5@70&10
Annealed Fence, Nos. 8 and 9	dis 75
Annealed Grape, Nos. 10 to 14	dis 75
Stub's Steel Wire regular	95c ℔ lb dis 30

Wrenches.

Coe's genuine	dis 50
Girard Standard	dis 70&10
Agricultural	dis 75&10
Mechanic's	dis 55&10& 5
Bemis & Call's Combination	dis 35
Donohue's Engineers	dis 20&10
Lamson & Sessions Engineers	dis 60
Billings & Spencer's Drop Forged	dis 25
William's " "	dis 25
Alligator " "	dis 40

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STEEL RAILS,

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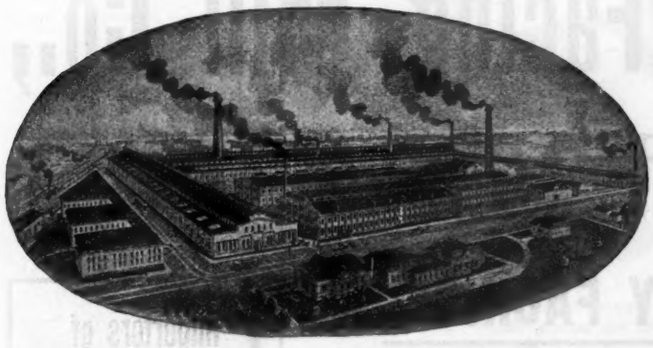
SHIP-YARD: Old River St., foot of Taylor St., Cleveland, Ohio.



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Electric Lighting Apparatus,
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For Sand Molds for Metal Castings.

Note the advantages of the **only Power Molding Machine adapted to different sizes and shapes of flasks:**

Our 16″ Duplex will mold, working Duplex, both parts of flask 12″x16″ and all sizes below; this same machine, when working Single will mold flask 16″x20″ and all sizes under.

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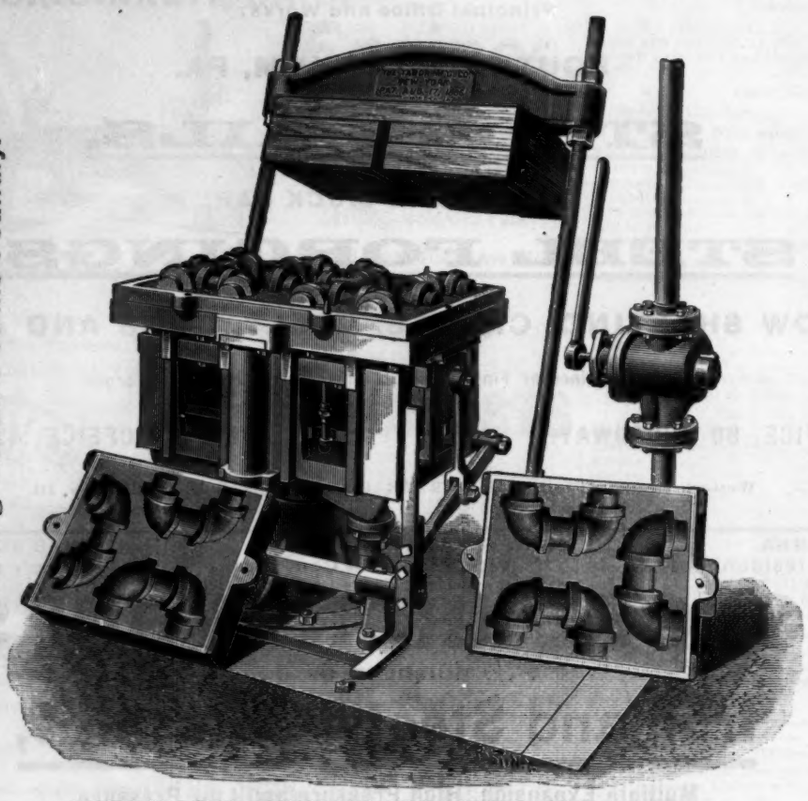
This feature allows a range of work, by one of our Machines, which would require a number of any other type. This is of the greatest importance to Foundries.

The Milling Machine of the Foundry.



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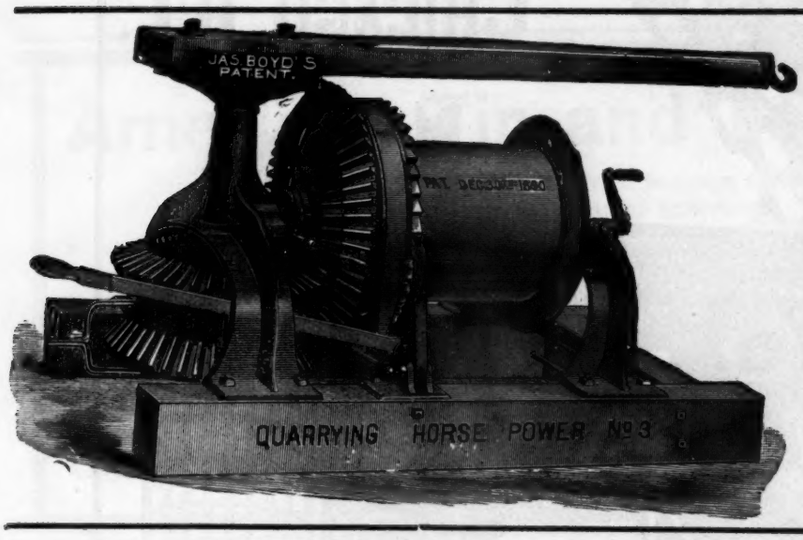

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Strongest and Most Serviceable.

Powerful Band Brake.
Automatic Safety Dog.
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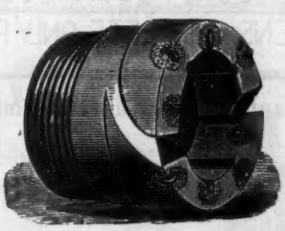

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BRONZE PLATES TO WITHSTAND THE ACTION OF MINE WATERS.

PLATES FURNISHED FLAT, OR ROLLED TO CYLINDRICAL FORM FOR REVOLVING SCREENS.

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By Our Improved Method of Cleaning Castings and the Surfaces of Metals

You secure results that cannot be obtained by any other known method. Nothing is left in the metal to injure it or affect the finishing afterward by Plating, Japanning, Galvanizing, Tinning, Enameling, etc. Acme Chemical Solution is in liquid form, put up in 100, 150, 200 and 400 lb. kegs and barrels, and is used diluted with water. It is now being used by the most prominent manufacturers and metal workers in all branches. Write for terms and descriptive pamphlet or order a package.

Try it and be convinced of its merits.

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For Blast Furnaces, Cupola Lining, Boiler Setting, Smoke Stack Lining, or Any Other Purpose.

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COAL, IRON ORE and PIG IRON.

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LORETTO, " "
FRANKLIN, Mesabi "
OLIVER, " "
SOUTH SIDE, " "
CHAPIN, Blue "
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ELK RAPIDS, Lake Superior Charcoal.
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MINERS AND SHIPPERS OF

Mansfield (Steam), Youghiogheny (Gas) Coals.

617 PERRY-PAYNE BUILDING, - - CLEVELAND, O.

The Reason Why.

Economy of fuel, rapid melting, the production of a uniform grade and strength of iron is attained in the highest possible degree in the BLAKENEY CUPOLA FURNACE is comprehensively shown in the following cuts:

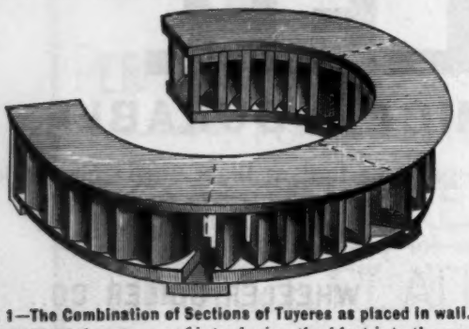

Fig. 1—The Combination of Sections of Tuyeres as placed in wall.

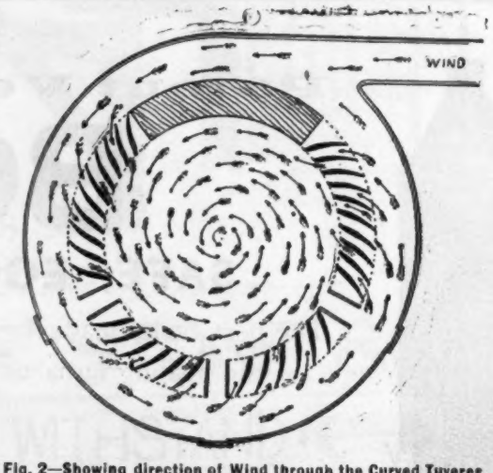

Fig. 2—Showing direction of Wind through the Curved Tuyeres.

Upon the manner of introducing the blast into the cupola depends the degree of combustion attained, consequently that form of tuyeres which will produce maximum results at a minimum cost is the great desideratum. We assert that this has been reached in the "Blakeney" tuyeres to a higher and more satisfactory degree than in any other device known, whether it be a combination of upper and lower tuyeres, a series of pipes, or the old-fashioned tuyeres; and we are certain that a little reflection on the part of any one familiar with cupola practice, will convince him that the projection of the blast through CURVED tuyeres will not only insure its penetration nearer to the center of the cupola, but its more even distribution to all parts of the cupola as well. It is upon this self-evident fact that we base our claim of the attainment of a combustion more nearly approaching perfection than by any other method. With better combustion it necessarily follows that there must be greater economy of fuel, faster melting, less "hanging up," and the production of a more uniform grade and strength of iron. In a word, the "Blakeney" cupola is a continual source of profit and satisfaction in a foundry, and to any one desirous of improving their melting facilities, or who are in the market for a new cupola, we shall be pleased to send a descriptive catalogue. We are quoting "hard time" prices and solicit the privilege of submitting figures. To those whose cupolas are being run at a daily loss as compared with the results attained in the "Blakeney," we desire to state that we are prepared to apply these patent tuyeres and air-chamber to old cupolas at a nominal cost when the shell is in good condition.

A FEW "STRAWS" SHOWING THE WAY THE BLAKENEY CUPOLA "WIND" BLOWS.

LANCASTER, PA., August 29th, 1894.

The Springfield Cupola Co., Springfield, Ohio.

GENTLEMEN: In answer to yours of the 27th inst. regarding the working of the Blakeney Cupola purchased from you in January last, we are pleased to state that since getting the Cupola in operation we have been in receipt of a number of inquiries from interested parties, and our reply has invariably been to the effect that the Cupola is giving us entire satisfaction. We never handled one that melts iron so rapidly, and for rapid work and satisfactory results with the castings we can cheerfully recommend it. Yours truly, THE HUBLEY MANF'G CO., F. H. Steacy, Sec'y.

FULTON, ILL., Aug. 29, 1894.

The Springfield Cupola Co., Springfield, Ohio.

GENTLEMEN: Replying to your favor of recent date we would say that it affords us pleasure to state that the No. 4 Blakeney Cupola bought of you last November is giving us just as good satisfaction as the Blakeney we had in use for fifteen years in our works at Tiffin, O. During this time we were familiar with cupolas of other makes, but knew of none which could give the good results attained in yours, consequently when we removed our plant to this city, and were in the market for a new cupola, we immediately communicated with you for the purchase of a new Blakeney. You may refer to us whenever the opportunity offers. Yours truly, THE MISSISSIPPI VALLEY STOVE CO.

THE SPRINGFIELD CUPOLA CO., Springfield, Ohio.

E. C. POPE.

SALES AGENT FOR

Lake Superior Iron Ores,

NORRIE AND PABST MINES.

DEALER IN ALL KINDS OF

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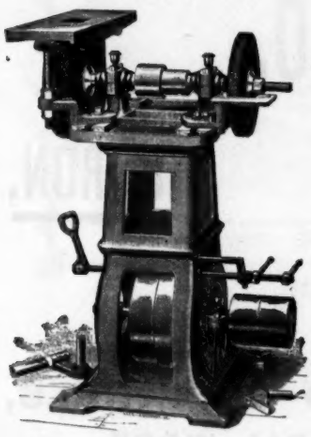

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EDWARD BROWN.

ESTABLISHED 1860.

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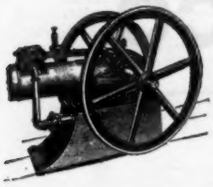

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Gas and Gasoline Engines

Are the latest and best Vertical and Horizontal Engines on the market. Simple and well constructed. . . . . .

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Stowe, Fuller & Co.

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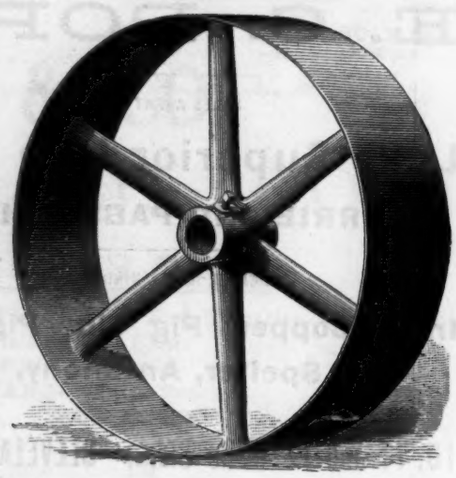

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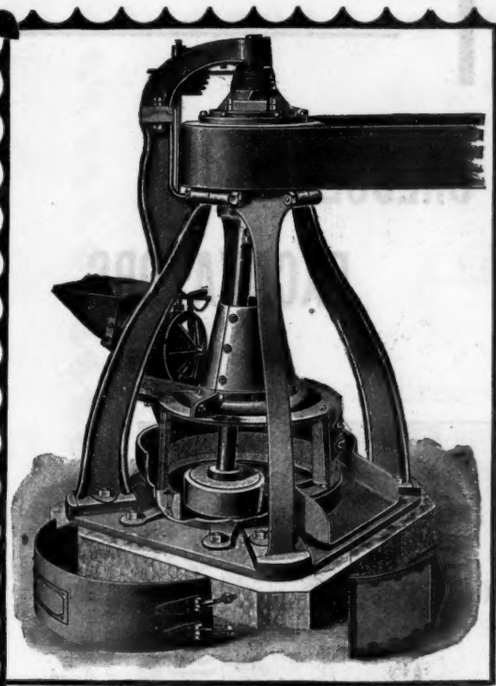

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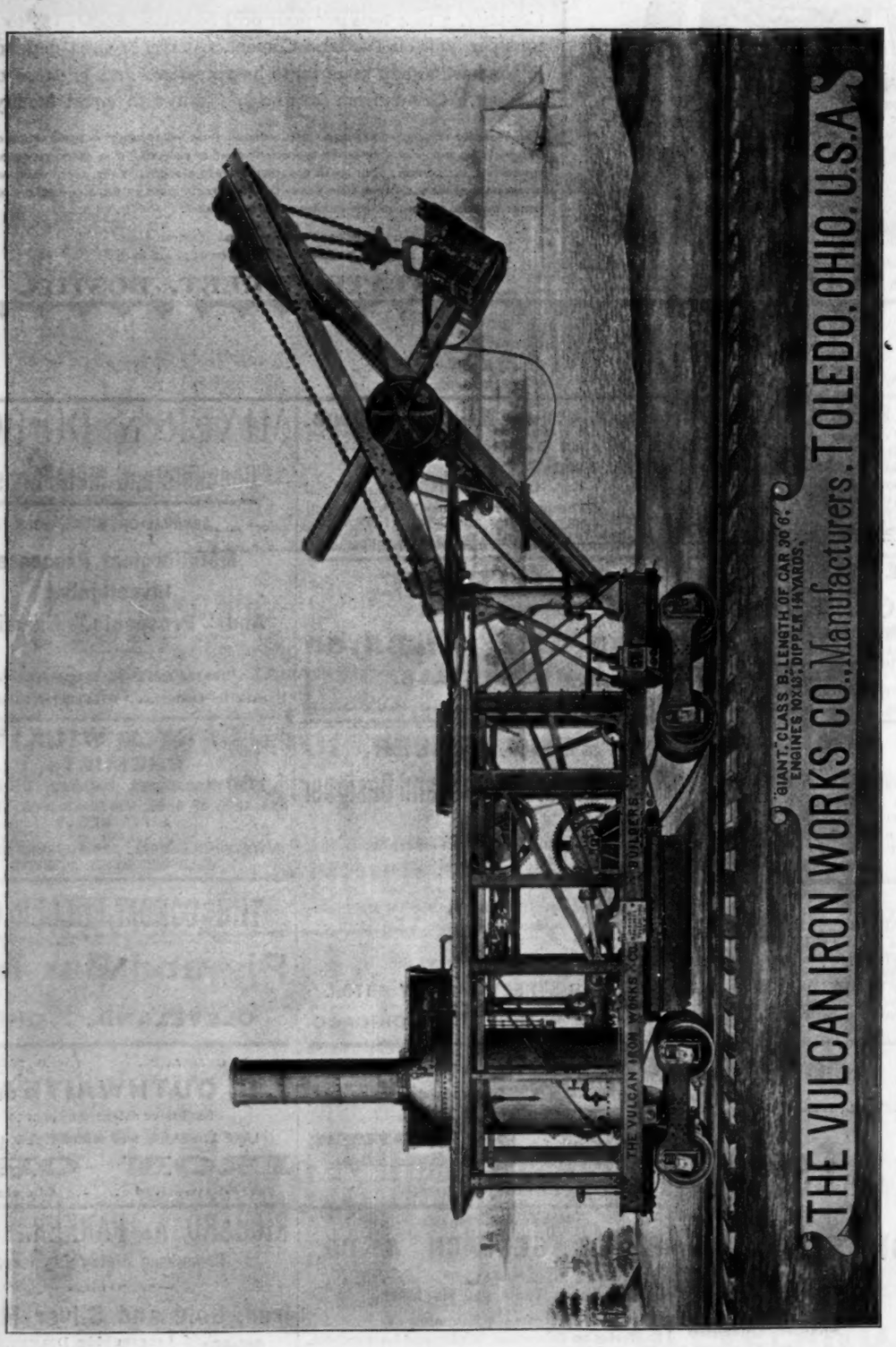
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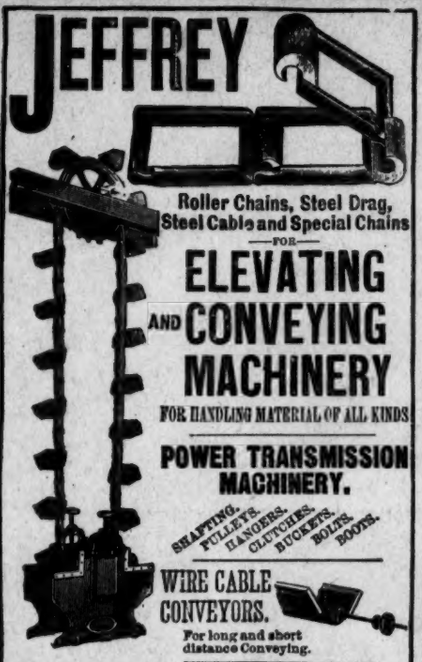

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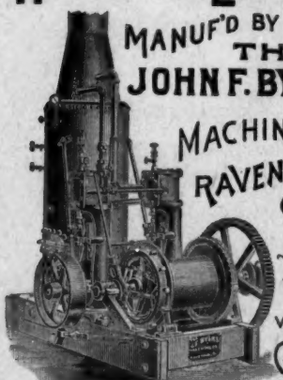

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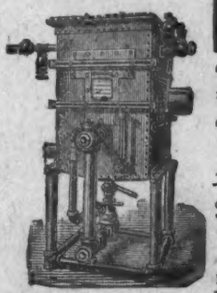

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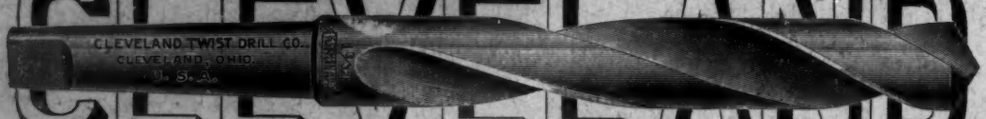

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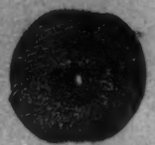

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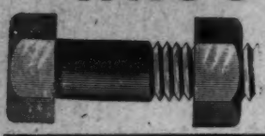

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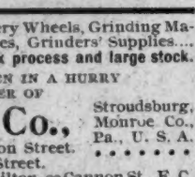

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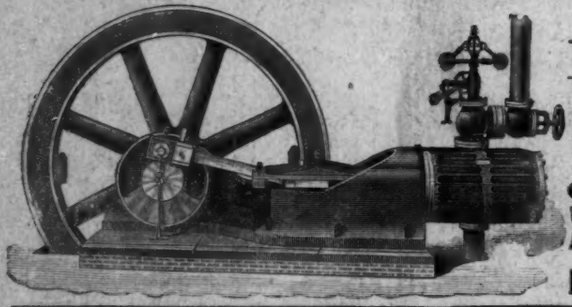

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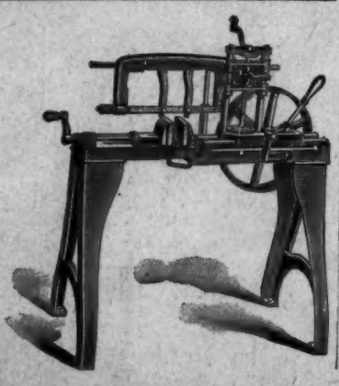

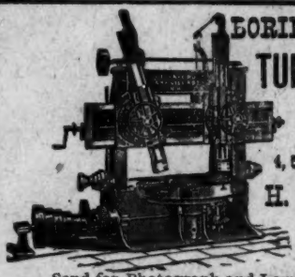

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